

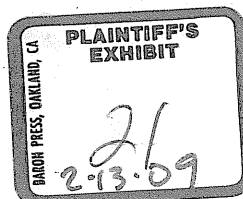
GROUNDWATER REMEDIATION PLAN

**FORMER Y-12 FACILITY
301 ORANGETHORPE AVENUE
ANAHEIM, CALIFORNIA**

**PREPARED FOR:
NORTHROP GRUMMAN SYSTEMS
CORPORATION**

URS PROJECT No. 27704081

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WORKPLAN

GROUNDWATER REMEDIATION PLAN FORMER Y-12 FACILITY 301 ORANGETHORPE, AVENUE ANAHEIM, CALIFORNIA

Prepared for

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1.2 REGIONAL GROUNDWATER CONTAMINATION

The former Y-12 facility is located within the downgradient portion of a regional groundwater contamination plume within the Santa Ana Forebay Groundwater Subbasin as identified by the Orange County Water District (OCWD, 1991). As a result of their study, the OCWD has identified an area of groundwater containing chlorinated VOCs that encompasses several square miles. These VOCs occur primarily in the shallowest water-bearing zones that occur within approximately 250 feet of the ground surface. VOCs are also present in deeper aquifers and have impacted certain municipal supply wells.

SECTION 2 CONCEPTUAL SITE MODEL

In order to plan and implement a successful remediation program, it is important to develop a comprehensive framework for a site that identifies source areas, contaminant types and characteristics, environmental factors such as geology and hydrogeology, potential exposure pathways and risk factors. This framework is often termed a Conceptual Site Model (CSM). The CSM is a dynamic model of site conditions that is subject to change, reinterpretation and modification based on the collection and analysis of new data. The following sections present our current CSM and frame the boundaries of the proposed remedial activity.

2.1 GEOLOGY

The Orange County Groundwater Basin is dominated by a deep structural depression containing a thick accumulation of freshwater bearing interbedded marine and continental sand, silt and clay deposits (DWR, 1967). The proportion of fine sediments generally increases toward the coast dividing the basin into what are referred to in the literature as forebay and pressure areas (DWR, 1967; OCWD, 1991).

The forebay area, encompassing most of the cities of Anaheim and Fullerton and portions of the City of Orange, is characterized by a stratigraphic sequence of relatively coarse-grained deposits of sands and gravels with occasional lenses of clay and silt. The sediments beneath the site have been described by previous consultants as unconsolidated alluvial sediments.

The sediments above approximately 70-feet below ground surface (bgs) are comprised predominately of poorly graded sand interbedded with thin beds of silts, silty sands and clayey sands. The sediments between approximately 70 feet to 100 feet bgs are described as predominately a clay interval with thin discontinuous beds of gravelly sands, sandy clays, silty clays and clayey sands. This clay interval has been described as an aquitard in the literature (OCWD, 1991). The sediments below the clay interval are characterized by poorly graded saturated sands to a depth of approximately 200 feet bgs. Figures 3 and 4 provide geologic cross sections through the former Y-12 facility site.

2.2 HYDROGEOLOGY

The Orange County Groundwater Basin underlies the northern half of Orange County beneath broad lowlands known as the Tustin and Downey Plains. The basin is divided into three aquifer systems: The Upper aquifer system; the Middle aquifer system; and the Lower aquifer system. Semi-perched aquifers at the surface overlay much of the central and coastal portions of the basin (Herndon, 1992). The eastern part of the basin is referred to as the Forebay and is where the majority of recharge occurs in the basin.

The Y-12 site is located within the Forebay area of Orange County Groundwater Basin. The uppermost regional aquifer beneath the site is the Upper aquifer that is encountered at depths of between 110 to 130 feet bgs. The first occurrence of groundwater beneath the site is in poorly graded sands at approximately 100-feet bgs, above the Upper aquifer in localized, small discontinuous semi-perched groundwater zones. According to Roy Herndon Manager of the Hydrogeology Department of the OCWD, the term "semi-perched" is used to describe any shallow water-bearing zone that, although underlain by fully saturated sediments, is substantially hydraulically separated from the underlying aquifers. It has been his

building. Extensive investigations were conducted in the vapor degreasing area formerly located within the Y-12 facility building. VOCs, primarily TCE and 1,1,1-TCA, were detected at concentrations of up to 590 ug/kg and 1,100 ug/kg, respectively. Boring CB-1 was drilled from the ground surface to approximately 91.5 feet below ground surface (bgs) in this area and TCE was detected in all but three of the 17 samples analyzed in this boring. Groundwater was encountered in boring CB-1 at approximately 90 feet bgs.

VOCs were also detected, but at significantly lower concentrations, in the vicinity of 1,1,1-TCA tank formerly located outside the western side of the building, the hazardous waste accumulation area north of the main building and near the electrostatic paint booth within the northwestern portion of the building (Figure 2). Based on the information currently available, these areas are not considered to be significant sources of residual VOC contamination.

2.5 FOCUS OF PROPOSED REMEDIATION

Because the former Y-12 facility is located within a known regional groundwater contamination plume and that the potential contribution of the facility, if any, to the Upper aquifer contamination is uncertain, the proposed remediation will address only VOC contamination of the semi-perched aquifer and residual VOCs in vadose zone soils beneath the facility. Remediation of residual VOCs in the vadose zone in recognized source areas will be addressed by soil vapor extraction (SVE) and the semi-perched zone will be effectively dewatered and treated by multi-phase extraction (MPE). The goal of this remediation effort is to mitigate residual contamination above the local aquitard and thereby mitigate potential future contribution to the regional VOC plume.

2.6 CSM SUMMARY

The following statements summarize the current framework of the CSM:

- Sandy soils are present from the ground surface to depths of between 50 and 70 feet bgs, followed by an interbedded transition zone of silts, clays and fine sands that is underlain by a 15 to 30 foot clay horizon that creates localized, semi-perched groundwater conditions.
- There are two primary and two secondary potential source areas for VOC contamination to soil and potentially groundwater at the former Y-12 facility. The primary source areas are the former quench tank and vapor degreasing areas. The secondary source areas are the waste management area and the former TCA tank area.
- Constituents of concern related to the former facility include primarily TCE, 1,1,1-TCA and their breakdown/transformation products.
- The relatively highest VOC concentrations are observed in shallow onsite wells screened within the transition zone and extending into the clay horizon of the semi-perched aquifer.
- Concentrations of VOCs in the Upper aquifer wells are generally low and similar to those observed in the regional plume monitoring data.
- The potential contribution of VOCs to the Upper aquifer from vadose zone and semi-perched groundwater contamination under the former facility is unproven based on the existing data.

SECTION TWO

Conceptual Site Model

- The most direct means of addressing facility-related groundwater contamination is to focus remediation on the vadose zone and water occurring in the semi-perched aquifer zone.

SECTION 3 REMEDIAL ALTERNATIVES EVALUATION

The purpose of this section is to identify, screen, and evaluate potential remedial alternatives to address vadose zone soil and semi-perched groundwater beneath the former Y-12 facility, where present, that are impacted with VOCs, primarily TCE and 1,1,1-TCA. Although numerical, site-specific cleanup objectives have not been established, this evaluation of alternatives was conducted to identify the most appropriate remedy for the remediation of VOCs in vadose zone soil and semi-perched groundwater to mitigate potential risks to deeper regional aquifers that underlies the site. Final remedy selection and design will be completed based on the results of the pre-design characterization work and the results of a pilot study recommended in this section.

Each of the identified alternatives is screened individually relative to established criteria. Selected alternatives are then evaluated separately and compared to each other on the basis of established criteria and the most appropriate remedy is selected, again, subject to verification with completion of the pre-design characterization and recommended pilot test.

3.1 IDENTIFICATION AND SCREENING OF REMEDIATION ALTERNATIVES

Preliminary identification and screening of remedial alternatives was conducted by URS, representatives of Northrop and other selected technical consultants. Remedial alternatives were identified based primarily on previous or published experience with relevant technologies and, accordingly, screened based on their expected effectiveness at this site, implementability, and cost. These screening criteria are defined as follows:

- *Effectiveness*, with primary consideration of the ability of the alternative to meet expected cleanup objectives (e.g. mitigation of potential threats to the regional aquifer).
- *Implementability*, with primary consideration of the technical and administrative feasibility of and availability of necessary equipment and personnel for implementation. This criterion also includes consideration of site access and expected state and community acceptance.
- *Cost*, including both capital and present value of operation and maintenance (O&M) costs, as applicable.

Several potential remedial alternatives were identified and evaluated as part of the remedy screening process. Identification and screening was based on URS' and the other technical consultants experience at other sites with similar conditions and published case-studies and guidelines. Remedial alternatives considered for this site included soil vapor extraction (SVE), multi-phase extraction (MPE, including two-phase extraction [TPE] and dual-phase extraction [DPE]), in-well stripping, groundwater pump and treat, *in situ* chemical oxidation (ISCO), and excavation/large diameter auger (excavation). Air sparging was also considered in preparation of this report.

Although in-well stripping can simultaneously address both vadose zone soils and groundwater, it was eliminated for further consideration because of the inconsistent extent and thickness of groundwater occurring in the semi-perched groundwater zone. Groundwater pump and treat was eliminated because of the typically high cost, limited performance, and likely low volume of water that can be extracted from the semi-perched groundwater zone. Also, pump and treat must be combined with other technologies to address the vadose zone soils. ISCO was eliminated as insufficient site data is available to fully assess its

potential effectiveness and because it would also have to be combined with other technologies to address the vadose zone soils. Implementation is also complicated by the inconsistent extent and thickness of groundwater occurring in the semi-perched zone. Excavation was eliminated because of the depth to the groundwater, difficulties associated with excavating beneath an existing building (e.g., risk to structure and interference with current site operations), and expected high cost for implementation. Air sparging was eliminated because of heterogeneous lithology and limited thickness of the semi-perched groundwater zones with the resulting limitation in developing effective sparge air distribution.

SVE and MPE were carried forward for further evaluation, with SVE being implemented to address impacted vadose zone soils where VOCs may occur above the semi-perched groundwater zone. MPE, which includes SVE, would be implemented at locations requiring remediation of semi-perched groundwater. Vadose zone soils would be addressed simultaneously with MPE.

SVE is identified by EPA as a presumptive remedy for VOCs in vadose zone soils (EPA, 1993 and 1993). Similarly, MPE is identified by EPA as a presumptive remedy for VOCs in vadose zone soils and groundwater (EPA, 1997). The presumptive remedy approach provides an expedited remedy selection process acknowledging past performance of certain technologies in addressing common categories of contaminants and site conditions (EPA, 1993). In this approach, the preferred presumptive remedy need only be compared to the No Action alternative. Accordingly, the following remedial alternatives were selected for evaluation:

- Alternative 1 – No Action
- Alternative 2 – Soil Vapor Extraction/Multi-phase Extraction

SVE and MPE are combined into one alternative, with MPE implemented based on the occurrence of the semi-perched groundwater.

3.2 DESCRIPTION AND EVALUATION OF REMEDIAL ALTERNATIVES

Although the EPA presumptive remedy approach identifies SVE/MPE as an appropriate technology for remediation of VOCs in soil and groundwater, this section was prepared to provide a description of each remedial alternative selected for evaluation, provide specific rationale for the selection of each alternative for evaluation, and a description of the technology as it applies to this site. This section also provides an evaluation of each remedial alternative compared to nine criteria for feasibility studies defined in Section 300.430 (e) (9) (iii) of the U.S. Environmental Protection Agency (EPA) National Oil and Hazardous Substances Pollution Contingency Plan, or NCP (USEPA, 1990). These nine criteria are identified and described as follows:

1. *Short-term effectiveness* – This criterion evaluates the effects of the remedial alternative during the construction and implementation phase until remedial objectives are met. It accounts for the protection of workers and the community during remedial activities, and environmental impacts from implementing the action.
2. *Long-term effectiveness and permanence* – This criterion addresses issues related to the management of residual risk remaining onsite after a remedial action has been performed and has met its objectives. The primary focus is on the controls that may be required to manage risk posed by treatment residuals and/or untreated wastes (e.g., continued groundwater monitoring).

3. *Reduction of toxicity, mobility, or volume* – This criterion evaluates whether the remedial technology employed results in significant reduction in toxicity, mobility, or volume of the hazardous substances.
4. *Implementability* - This criterion evaluates the technical and administrative feasibility of the alternatives, as well as the availability of the necessary goods and services. This includes the ability to construct and operate an alternative, ability to obtain services, and equipment, ability to monitor the performance and effectiveness of technologies, and the ability to obtain necessary approvals from agencies.
5. *Overall protection of human health and the environment* – This criterion evaluates whether the remedial alternative provides adequate protection to human health and the environment.
6. *Cost* – This criterion involves capital and operation and maintenance cost and is based on a variety of information. The actual costs will depend on true labor and material cost, competitive market conditions, final project scope, including defined lateral and vertical extent of contamination identified during the pre-design site characterization work, and the implementation schedule.
7. *State Acceptance* – This criterion involves consideration of the involved regulatory agency acceptance of a remedial alternative.
8. *Community Acceptance* – This criterion involves consideration of the likelihood of community acceptance or concerns regarding implementation of a particular remedial alternative.
9. *Applicable or Relevant and Appropriate Requirements (ARARS)* – This criterion involves an evaluation of location-specific, chemical-specific, and action-specific ARARs.

Each remedial alternative is evaluated individually on these criteria and in comparison to other alternatives.

3.2.1 Alternative 1 – No Action

In accordance with NCP and CERCLA, as amended, Alternative 1 has been included to provide a baseline for comparison to other remediation alternatives. This alternative includes no institutional controls, no treatment of soil or groundwater, and no monitoring. No cost is associated with this alternative.

3.2.1.1 Evaluation

1. *Short-term effectiveness* – Because no remedial actions are undertaken, protection of workers or the community during implementation are not required. Cleanup objectives, however, are not met.
2. *Long-term effectiveness and permanence* – Because no remedial actions are undertaken and cleanup objectives are not achieved, long-term effectiveness and permanence are not achieved and risks are not reduced.
3. *Reduction of toxicity, mobility, or volume* – Because no remedial actions are undertaken, toxicity, mobility, and volume are not reduced.

4. *Implementability* – Because no remedial action is undertaken, there are no restrictions on implementability. However, agency approval would not be granted because cleanup objectives are not achieved.
5. *Overall protection of human health and the environment* – Reduction in human health risk is not achieved because soil and semi-perched groundwater impacted with VOCs are not remediated.
6. *Cost* – There is essentially no cost in implementation of this alternative.
7. *State Acceptance* – Because cleanup objectives are not achieved and human health risk is not reduced, involved agencies would not be expected to accept this alternative.
8. *Community Acceptance* – Because cleanup objectives are not achieved and human health risk is not reduced, involved agencies would not be expected to accept this alternative.
9. *ARARs* – Because cleanup objectives are not achieved and human health risk is not reduced, ARARs would not be met.

3.2.2 Alternative 2 – Soil Vapor Extraction/Multi-phase Extraction

SVE and MPE are combined into one alternative, with MPE implemented based on the occurrence of the semi-perched groundwater. In impacted areas with no semi-perched groundwater, SVE wells would be constructed to facilitate extraction of soil vapor from vadose zone soils. In impacted areas with semi-perched groundwater, MPE wells would be constructed to facilitate the simultaneous extraction of groundwater and soil vapor. Extracted soil vapor and groundwater would be transferred to a combined treatment system for treatment prior to discharge, as described below.

SVE is a developed technology and recognized as the preferred presumptive remedy for the remediation of VOCs in soil (USEPA, 1993). SVE involves removal of VOCs from impacted soils with extracted soil vapor by applying a vacuum to extraction wells, constructed within the aerial boundary of the impacted soil at the Site, using a blower and interconnecting piping. The SVE wells typically consist of slotted PVC casing installed in a vertical wellbore and/or horizontal trench. Wellfield design is based on economic optimization of the number and location of wells (vertical or horizontal) necessary to appropriately intercept and remediate impacted soil in areas exceeding cleanup objectives. A schematic diagram of a typical SVE system is provided as Figure 5, as part of the SVE/MPE system.

For this site, URS expects that SVE wells would be constructed from land surface to the top of the clay aquitard, at a total depth of approximately 80 to 90 feet bgs. Cluster wells may be required to address the variability in lithology from ground surface to total depth with a generally decreasing permeability. Cluster wells provide a means of segregating extraction from comparatively high (e.g., sand) and low (e.g., silt and clay) permeability soils thus minimizing preferential flow from high permeability soils. In general this distinction occurs at approximately 60 feet bgs (see Figures 3 and 4).

The extracted soil vapor is treated before discharge to the atmosphere typically using vapor phase carbon adsorption (VPCA) or thermally, using a catalytic oxidizer (for chlorinated VOCs). The SVE system would remove the VOCs within the vadose zone by creating movement of air through the impacted soil. As the air passes through the impacted soil, VOCs volatilize from the liquid to the vapor phase. The VOCs are destroyed or removed from the off-gas of the vacuum unit by a thermal oxidizer or using VPCA, respectively. Regular monitoring of the SVE system includes measuring the concentrations of VOCs in the soil vapor stream as it is

removed from the extraction wells and from effluent stream from the vapor treatment unit. Given the comparatively low known concentrations of VOCs in subsurface soils, VPCA would likely be used for vapor treatment.

Pilot testing of SVE is typically conducted to obtain data necessary for detailed wellfield design (e.g., radius of influence), equipment selection (e.g., initial concentrations and soil vapor flowrates), and optimization of the design of a full-scale SVE.

MPE is a developed technology and recognized as the preferred presumptive remedy for the remediation of VOCs in groundwater (USEPA, 1997). MPE, a variation of SVE, provides for simultaneous extraction of groundwater and soil vapor. Using MPE, soluble VOCs present in groundwater are extracted from the subsurface in groundwater and are also removed in soil vapor as described for SVE, above. Groundwater extraction typically results in lowering of the groundwater table thus exposing additional soil to SVE and expediting remediation.

Two typical variations of MPE are TPE and DPE. TPE uses a high vacuum pump, typically operating at 18 to 25 inches of mercury (Hg), to extract both soil vapor and groundwater from an extraction well. Soil vapor extraction is accomplished as described above. Groundwater extraction is accomplished by applying the vacuum to a small diameter suction tube that is positioned within the well casing with the end located in groundwater. Depending on site conditions and extraction well design, groundwater may be extracted as a stream through the tube or as an entrained liquid for groundwater at depths exceeding approximately 25 feet bgs. The resulting turbulence in the entrained water stream also results in transfer of VOCs from the liquid phase to the vapor phase – again improving system performance. Additionally, extraction wells can be easily configured for either SVE-only or TPE use with the simple addition of the suction tube. This would provide great flexibility in operation and in minimizing cost. In DPE, a pump is used to extract groundwater instead of a suction tube. The pump may be pneumatically or electrically operated. Because of the limited occurrence and thickness of the semi-perched groundwater, however, use of a pump is not expected to be cost effective or provide substantially improved performance over TPE. Accordingly, URS expects that TPE would be most appropriate for this site. Figure 5 is provided to illustrate the configuration of the proposed SVE/MPE system.

The vapor and liquid streams from the extraction wells are transferred in collection system piping to an inlet separator to separate the vapor stream for treatment in the vapor treatment system prior to discharge to the atmosphere and the liquid stream for treatment in a liquid treatment system, prior to discharge. Given the known concentrations of VOCs in the semi-perched groundwater, liquid phase carbon adsorption (LPCA) is expected to be selected for treatment of extracted groundwater.

Treated groundwater from a MPE system is typically discharged to the storm drain system under an NPDES permit issued by the RWQCB or possibly re-injected. Sanitary sewer discharge of treated groundwater may also be allowed under a Special Purpose Discharge permit issued by the sanitary sewer operating authority. Pilot testing of MPE is recommended to evaluate groundwater production rates and obtain other data necessary for full-scale design.

Startup and operation of the SVE/MPE system involves periodic sampling and analysis of extracted soil vapor and groundwater influent and effluent streams and recording key operational data. System operation also includes periodic optimization, maintenance, and reporting.

The time required to operate the SVE/MPE system would be evaluated after completion of the pre-design site characterization and finalization of cleanup objectives for the site. During operation, the SVE/MPE system would require regular system maintenance, system performance monitoring, sampling of the extracted soil vapor and groundwater, and sampling of the treated soil vapor and groundwater. System O&M is normally continued until cleanup objectives are met or until concentration of VOCs in the extracted soil vapor and groundwater reach asymptotic levels and the rate of mass reduction is considered minimal. This would be an indication that the system has been operated to the approximate limits of its effectiveness and continued operation would not result in an appreciable reduction in concentrations of VOCs.

After operational data and confirmation samples indicate that the cleanup objectives have been achieved or asymptotic performance has been reached, a closure report is prepared to document system performance and rationale for closure. For this site, confirmation sampling may consist of soil vapor and groundwater sampling and analysis for VOCs for comparison to cleanup objectives. After agency concurrence that cleanup objectives have been achieved, the system is demobilized and the extraction wells properly abandoned.

3.2.2.1 Evaluation

1. *Short-term effectiveness* – Issues related to short-term effectiveness (e.g., protection of workers and the community) can be addressed by engineering controls during construction and O&M. Engineering controls include monitoring ambient VOC concentrations during drilling operations and shutting down or application of vapor suppressant, if health based criteria are exceeded. Engineering controls during O&M include operation and monitoring of vapor and groundwater treatment equipment.
2. *Long-term effectiveness and permanence* – Long-term effectiveness and permanence is provided by removal of VOCs from the vadose zone soil at the Site through vapor extraction and VPCA treatment of groundwater through groundwater extraction and LPCA treatment. VPCA and LPCA units are typically transported off-site for regeneration or thermal destruction at a properly licensed facility. Extracted groundwater and water entrained with the extracted soil vapor, recovered in the inlet scrubber, would be treated prior to discharge to the storm drain, sanitary sewer, re-injection or offsite disposal.
3. *Reduction of toxicity, mobility, or volume* – Toxicity and mobility of the waste is reduced through reduction in the volume from the vadose zone soil and groundwater through soil vapor and groundwater extraction.
4. *Implementability* – In general, equipment and personnel necessary for implementation of SVE/MPE are readily available. Permits and authorizations necessary for extraction well and system construction and operation are typically readily available – although a Special Purpose Discharge permit may not be issued for long-term operation. Extraction well and collection system piping construction within the building, however, can be difficult due to limitations for access of drilling or construction equipment and system maintenance. In addition, NGSC has not yet negotiated access to the site with the current property owner for these activities.
5. *Overall protection of human health and the environment* – Given the demonstrated effectiveness of SVE/MPE in remediation of VOCs in vadose zone soil and groundwater, respectively, and VPCA and LPCA for vapor and water treatment prior to discharge, respectively, this alternative would be protective of human health and the environment.

6. *Cost* – The cost of implementation of SVE/MPE is typically considered “medium”, relative to other viable technologies. For this site, a cost estimate for full scale implementation has not been prepared, pending completion of the pre-design site assessment.
7. *State Acceptance* – State acceptance of SVE/MPE is expected because cleanup objectives can be met and human health risk can be reduced.
8. *Community Acceptance* – Community acceptance of SVE/MPE is expected because cleanup objectives can be met, human health risk is reduced, and short-term impacts can be controlled.
9. *ARARS* – ARARS for SVE/MPE can be met.

3.3 COMPARATIVE EVALUATION OF REMEDIAL ALTERNATIVES

This section provides a comparative evaluation of the two remedial alternatives based on their comparison to the nine evaluation criteria. Following the discussion of the comparative evaluation is a numerical ranking of alternatives based on the degree to which each alternative satisfies the evaluation criteria. This analysis is based on numerical rankings that assign values according to the following:

- A value of “3” is awarded if the alternative satisfies essentially all the elements of the evaluation criteria.
- A value of “2” is awarded if the alternative satisfies some of the elements of the evaluation criteria.
- A value of “1” is awarded if the alternative satisfies few or essentially none of the elements of the evaluation criteria.

With respect to cost, values are assigned relative to the lowest (“3”) to highest (“1”) total estimated cost (present value, where applicable). Alternatives with comparable overall performance are assigned the same value. Absent other controlling factors, the remedial alternative with the highest total rating (score) is considered to be the most appropriate.

3.3.1 Discussion

1. *Short-term effectiveness* – Alternative 1 poses no short-term risk in implementation as no remedial action is undertaken. Alternative 2 poses short-term risk associated primarily with construction of the SVE/MPE system, including noise, vapors, dust, or particulates that may be generated during drilling or construction activities. These risks could be mitigated, however, using personal protective equipment (PPE) for on-site workers and engineering controls, such as dust suppression and additional traffic control and equipment operating safety procedures, for protection of the surrounding community. During operation risk could be controlled by providing adequate vapor and groundwater treatment and monitoring of the extracted soil vapor and groundwater during operation of the SVE/MPE system.
2. *Long-term effectiveness and permanence* – Alternative 1 provides no long-term effectiveness and permanence as no active remediation is undertaken. Alternative 2 provide long-term effectiveness and permanence with extraction of impacted soil vapor and groundwater exceeding cleanup objectives.

3. *Reduction of toxicity, mobility, or volume* – No reduction in toxicity, mobility, or volume is provided with Alternative 1. Toxicity, mobility, and volume of contamination at the Site would be reduced with removal and treatment of soil vapor and groundwater with concentrations of VOCs above cleanup objectives. Mobility and potentially, toxicity and volume, would be further reduced at the off-site treatment/disposal facility.
4. *Implementability* – Alternative 1 would not be implementable because agency approvals could not be obtained. Equipment, personnel, and materials necessary for implementation of Alternative 2 is widely available and necessary permits and authorizations could likely be obtained. Implementation would need to address building access and protection during construction and O&M.
5. *Overall protection of human health and the environment* – Alternative 1 does not provide protection of human health and the environment as elevated concentrations of VOCs would remain in site soils and groundwater. Alternative 2 provides suitable performance as long-term risks are reduced and human health and the environment are protected. Short-term risks can be controlled.
6. *Cost* – Alternative 1 can be implemented at essentially no cost. The cost for full-scale implementation of Alternative 2 has not been estimated, pending completion of the pre-design site assessment.
7. *State Acceptance* – Alternative 1 would not be accepted by the state because cleanup objectives are not achieved. Because of the ability to achieve cleanup goals with this alternative, state acceptance of Alternative 2 would be expected.
8. *Community Acceptance* – Alternative 1 would not be accepted by the community because cleanup objectives are not achieved. Because of the ability to achieve cleanup goals with this alternative, state acceptance of Alternative 2 would be expected.
9. *Compliance with ARARs* – Alternative 1 would not comply with ARARs. Alternative 2 would be expected to comply with ARARs.

3.3.2 Comparative Ranking

Based on the discussion provided above, score values for each of the criteria were assigned as follows:

Criteria	Alternative 1 – No Action	Alternative 2 – Soil Vapor Extraction
Short-term Effectiveness	3	2
Long-term Effectiveness and Permanence	1	3
Reduction of Toxicity, Mobility, and Volume	1	3
Implementability	1	3
Overall Protection of Human Health and the Environment	1	3
Cost	3	2
State Acceptance	1	3
Community Acceptance	1	3
Compliance with ARARs	1	3
Total Score	13	31

3.4 SELECTED REMEDIAL ALTERNATIVE

Based on the results of the comparative evaluation, Alternative 2 – Soil Vapor Extraction/Multi-phase Extraction is selected as the most appropriate remedy for addressing site soils and semi-perched groundwater impacted with VOCs at the site. Implementation of Alternative 2 would require conducting pilot testing of the technology, completion of the pre-design characterization, system construction, and O&M, including conducting an evaluation of system performance and closure sampling and analysis, as described below.

3.4.1 System Configuration

In general, the SVE/MPE system would consist of a series of SVE and MPE extraction wells, vapor and liquid collection system piping, a high vacuum blower unit, including inlet scrubber, and VPCA and LPCA units for vapor and water treatment, respectively. Until completion of the pre-design characterization work and pilot testing, however, the extraction wellfield and treatment system cannot be designed. A schematic diagram of the proposed SVE/MPE system is included as Figure 5.

However, based on the technical approach described in this document, URS expects that a series of nested, vertical SVE wells would be constructed in areas with residual VOCs present in the vadose zone. The screened intervals would be selected to target vadose zone soils impacted with VOCs at concentrations that pose a potential risk to groundwater. Screened intervals would also be selected to address major differences in lithology with depth, where present, to minimize preferential flow through high permeability soils. MPE would be constructed in a similar manner; however, a small diameter (estimated 1-inch nominal diameter) suction tube would be installed to extract the semi-perched groundwater.

Vacuum required for extraction of soil vapor and groundwater would be provided using a high vacuum, liquid ring pump. Valves would be provided at each extraction well to allow for adjustment and wellfield optimization. Sample ports would be provided at each extraction well to facilitate soil vapor and groundwater sampling and analysis and monitoring of vacuum levels.

The vapor and groundwater collection system piping would consist of a combination of above and below grade PVC piping to interconnect the extraction wells with the treatment system. The treatment system would consist primarily of the inlet separator, liquid ring pump, and VPCA and LPCA units. Individual VPCA and LPCA units would be connected in series and also equipped with sample ports. Treated soil vapor would be discharged to the atmosphere. Treated groundwater would likely be discharged to the storm drain system under an NPDES permit or to the sanitary sewer under a Special Purpose Discharge permit. Again, until the wellfield is designed, the pump and treatment units cannot be selected.

3.4.2 Permitting

Permits for construction (and abandonment after completion) of the SVE/MPE wells will be obtained as required. A permit for construction and operation of the vapor treatment system, expected to use VPCA, will be required from the South Coast Air Quality Management District (SCAQMD). A permit for discharge of treated groundwater will be required. If discharge to the sanitary sewer is acceptable, a Special Purpose Discharge Permit will be required. If discharge to the sanitary sewer is not possible, an

SECTION THREE

Remedial Alternatives Evaluation

NPDES permit will be obtained from the RWQCB if the volume of treated water is sufficient to warrant this form of discharge. If water volumes are low, offsite disposal may be performed. Re-injection of the treated groundwater is not expected to be selected. Additionally, a building permit will be required from the City of Anaheim for general electrical, structural, and mechanical work associated with construction of the soil vapor and groundwater collection and treatment systems.

3.4.3 Operation and Maintenance

In preparation for operation, the SVE/MPE system will be inspected, rotating equipment will be lubricated, and operation tested. After start-up, operational data, including soil vapor and groundwater flowrate, influent and effluent concentrations of VOCs, vacuum levels, and liquid levels will be recorded and the system inspected on an approximate weekly basis. During operation, extraction well valving may be periodically adjusted to optimize VOC removal and system performance. Influent and effluent concentrations in the vapor stream are typically measured using a field instrument, or photo-ionization detector (PID).

Routine maintenance will include periodic replacement of vacuum pump lubricating oil, greasing the blower electrical motor, and general housekeeping. Other maintenance work would also include change-out of the VPCA and LPCA units. VPCA and LPCA unit change-outs are required after effluent concentration data indicates that breakthrough is occurring.

During operation, quarterly system performance reports will be prepared. These reports will summarize key operational data; especially estimated mass removal and influent concentrations. Quarterly reports will also be prepared and submitted to the SCAQMD.

3.4.4 Closure Sampling and Analysis

During operation, performance data will be evaluated to verify expected decreasing, asymptotic concentrations of VOCs in the extracted soil vapor and groundwater. Based on review of the performance data collected during a minimum O&M period of approximately 6 to 12 months, and in consultation with the RWQCB, soil vapor and groundwater sampling would be conducted to determine if cleanup objectives have been met and operations can be ended.

If cleanup objectives are met, a closure report will be prepared and submitted to the RWQCB and the SVE/MPE system will be removed. The closure report will be prepared to summarize remediation activities and system performance and present the results of closure sampling and rationale for site closure.

3.4.5 System Demobilization

After verification that cleanup objectives have been achieved, the SVE/MPE system will be properly demolished and removed from the Site. Activities will include proper abandonment of the SVE/MPE wells under applicable permits and procedures, removal and off-site regeneration or disposal of the VPCA and LPCA units at a properly licensed facility, transportation and proper disposal of any other hazardous or non-hazardous wastes (e.g., residual knock-out vessel liquids, trash, construction debris), and removal of all above-

SECTION THREE

Remedial Alternatives Evaluation

ground piping and equipment. The fence surrounding the treatment equipment will also be removed. Wastes will be transported and disposed of under appropriate waste manifests.

SECTION 4 PILOT TEST WORKPLAN

Prior to completing the design and implementation of a full-scale SVE/MPE system, pilot testing is recommended. The data obtained from the pilot test, as well as any additional pre-design characterization work, will be used as a basis to design the full-scale system. This section describes the objective, scope, and requirements for a proposed pilot test of SVE/MPE at the site.

4.1 PILOT TEST OBJECTIVES

The general objective of the pilot test is to obtain performance data during operation of a pilot-scale SVE/MPE system to be used in verifying the selection of SVE/MPE as the most appropriate remedial alternative and to obtain data for use in design of a full-scale system to achieve site cleanup objectives. More specific objectives of the pilot test are identified as follows:

1. Estimate the rate of soil vapor and groundwater extraction from NMW-2A.
2. Measure the concentration of VOCs in the extracted soil vapor and groundwater.
3. Estimate the mass removal rate of VOCs in the extracted soil vapor and groundwater.
4. Estimate the radius of vacuum influence (ROI) within the sandy zone (0 to 70 feet bgs) and within the semi-perched zone.
5. Evaluate the possible impact to groundwater levels measured in new monitoring wells, during the short duration pilot test period.
6. Evaluate the performance of SVE/MPE at varying vacuum levels.
7. Evaluate the effectiveness of TPE in remediation using SVE/MPE.
8. Identify key design parameters for design of a full-scale SVE/MPE system.

4.2 PILOT TEST WELLFIELD**4.2.1 Extraction Well**

The proposed pilot test is designed to use existing groundwater monitoring well NMW-2A, currently used to monitor the semi-perched groundwater to the east of Building Y-12, as the MPE extraction well. NMW-2A was constructed to a total depth of approximately 95 feet bgs with slotted screen placed between 85 and 95 feet bgs. NMW-2A is included in the geologic cross section illustrated in Figures 3 and 4.

Groundwater elevation measured in this well was reported at 89.59 feet bgs during the most recent groundwater monitoring event conducted on June 7, 2004. Well NMW-2A, along with well NMW-5A, are the only semi-perched zone wells that consistently contain measurable levels of groundwater. The concentration of TCE in groundwater samples collected from NMW-2A has varied from ND to 960 ug/L, and was reported as 230 ug/L during the groundwater monitoring event conducted on April 6, 2004.

This well location was selected for pilot testing of SVE/MPE based on the consistent presence of semi-perched, VOC-impacted groundwater, suitable well screen interval, and accessibility, given its location outside of Building Y-12 and corresponding minimal impact to ongoing site operations during the pilot test.

The depth of the screened interval in this well will facilitate combined SVE/MPE pilot testing of the predominantly clayey and relatively consistent confining layer (occurring approximately 70 to 100 feet bgs) with the installation of a 1-inch diameter suction pipe and corresponding wellhead fittings and mobilization of appropriate pilot test equipment, as described in this section. Approximately 5 feet of the 100 foot well screen is located in vadose zone soil, above the most recently reported groundwater elevation. However, the configuration of this well will not facilitate SVE testing of the upper, more permeable vadose zone soils from approximately 0 to 70 feet bgs. SVE testing of this interval will be accomplished using the proposed new monitoring wells described below. Because of the depth of the groundwater (greater than 25 feet), groundwater will only be extracted as entrained with soil vapor flow in the suction tube using TPE. This arrangement is expected to be suitable as the rate of groundwater extraction is expected to be comparatively low.

4.2.2 Monitoring Wells/SVE Test Wells

To evaluate the performance of monitoring well NMW-2A under SVE/MPE, a group of three nested monitoring/SVE wells will be constructed at varying distances (approximately 10, 30, and 60 feet) from NMW-2A. These wells will be designated NMW-11, 12, and 13. Then actual locations will be selected based on site access limitations. The lower screened interval in these wells will be used for measurement of groundwater levels and vacuum to facilitate estimating radius of influence of SVE in the clayey confining layer (approximately 70 to 100 feet bgs). The upper screened interval will be used primarily for pilot testing and monitoring of SVE of the upper more permeable vadose zone soils (approximately 0 to 70 feet bgs). Additionally, these wells will also be beneficial in delineating the extent of impacted semi-perched groundwater. These wells may also be used as part of the full-scale SVE/MPE remediation system. A schematic diagram illustrating the construction of these proposed monitoring wells is provided as Figure 6.

The new monitoring wells will be constructed using a hollow stem auger drill rig to a total depth of approximately 95 feet bgs, similar to NMW-2A. The upper screened interval will be completed from approximately 30 to 70 feet bgs, targeting the expected more permeable soil in the upper vadose zone and representative of shallow soil conditions in Building Y-12. The lower screened interval will be completed between approximately 80 to 95 feet bgs, targeting the possible semi-perched groundwater and vadose zone soils in this interval.

Prior to construction, URS will contact Underground Service Alert (USA) at least 24 hours before drilling operations to locate possible underground utilities. URS will also review available facility drawings and use a subcontract utility locating company to assist in locating possible underground utilities.

4.3 SVE/MPE TEST EQUIPMENT

The pilot test will be conducted using a mobile, rental SVE/MPE pilot test unit, available from a variety of suppliers in the Los Angeles and Orange County areas. The unit will consist primarily of a vacuum

blower (likely a liquid ring pump) capable of extracting up to 250 standard cubic feet per minute (SCFM) of soil vapor at a vacuum of up to 25 inches of mercury. Ideally, the unit will be provided with a various locations permit issued by the SCAQMD with vapor treatment using VPCA. VPCA will consist of two suitably sized granular activated carbon (GAC) units arranged in series and equipped with valved sample ports to facilitate soil vapor sampling and vacuum measurement.

The unit will also be equipped with an inlet scrubber used to separate the vapor and liquid stream. The liquid (groundwater) stream will be pumped from the scrubber to a storage tank. Accumulated groundwater will be periodically transported off-site for treatment and disposal at a licensed facility, under an appropriate hazardous waste manifest.

Initially, the pilot test unit will be connected to monitoring well NMW-2A to evaluate the performance of MPE in extraction of groundwater and soil vapor from the semi-perched zone. Connections will be made using PVC piping temporarily routed along the surface. As a second phase, the pilot test unit will be connected to the upper screened interval of one of the new monitoring wells to evaluate the performance of SVE above the semi-perched zone. Wells not connected to the pilot test unit during testing will be monitored as described later in this section.

To operate the liquid ring pump and the control system, temporary electrical power will be obtained from existing service in Building Y-12. Alternatively, a portable generator will be mobilized to the site. A schematic diagram of the pilot test system is included as Figure 5.

4.4 SVE/MPE TEST PROCEDURE

4.4.1 MPE Pilot Test

1. Permit and construct new monitoring wells NMW-11, NMW-12, and NMW-13. Conduct initial monitoring of the new wells as well as NMW-2A.
2. Obtain SCAQMD permit for operation of the pilot test system, if pre-permitted equipment is not available.
3. Mobilize and assemble pilot test equipment, including temporary connection to electrical power.
4. Install suction tube in NMW-2A and connect well to the pilot test system.
5. Begin operation of the pilot test system and adjust operation to apply a vacuum of approximately 10 inches Hg. Stabilize the vacuum measured in NMW-2A, continue to operate for a minimum period of approximately 3 hours, longer if vacuum response in adjacent monitoring wells has not stabilized.
6. During the 3 hour test period, record vacuum levels in NMW-2A and each of the three new monitoring wells within the first 5 minutes of operation, every 15 minutes thereafter. Record the soil vapor and groundwater extraction flowrate and concentration of VOCs in the extracted soil vapor from NMW-2A at the same interval. VOC concentrations will be measured using a PID. Collect samples of extracted soil vapor and groundwater for laboratory analysis for VOCs during the pilot test – one at approximately 30 minutes and one at approximately 3 hours, near the end of the pilot test. Measure and record groundwater elevations in NMW-2A and each of the new

monitoring wells after 15 minutes of operation and every 30 minutes thereafter, during the pilot test. Measure and record the total volume of groundwater extracted as an entrained liquid at the completion of the test period.

7. Conduct monitoring, sampling, and laboratory analysis of the treated soil vapor, as specified in the SCAQMD permit.
8. The following day, repeat the test procedure at approximately 24 inches Hg, or the maximum attainable by the pilot test system.

If the use of the suction tube is deemed ineffective in extracting groundwater at depth during testing, pilot testing described above may be repeated using a pneumatic or electrically operated pump, as DPE.

4.4.2 SVE Pilot Test

1. Connect the pilot test system to the shallow screened interval of NMW-11.
2. Begin operation of the pilot test system and adjust operation to apply a vacuum of approximately 10 inches Hg. Stabilize vacuum and operate for a minimum period of approximately 2 hours, longer if vacuum response in adjacent monitoring wells has not stabilized.
3. During the 2 hour test period, record vacuum levels in NMW-11, NMW2A, and each of the other two new monitoring wells within the first 5 minutes of operation and every 15 minutes thereafter. Record the soil vapor extraction flowrate and concentration of VOCs in the extracted soil vapor at the same interval. VOC concentrations will be measured using a PID. If VOCs are detected in the extracted soil vapor using the PID, collect samples of extracted soil vapor for laboratory analysis for VOCs during the pilot test – one at approximately 30 minutes and one at approximately 2 hours, near the end of the pilot test. Measure and record the total volume of water that may have been extracted as an entrained liquid during testing.
4. Conduct monitoring, sampling, and laboratory analysis of the treated soil vapor, as specified in the SCAQMD permit.
5. Approximately 1 hour after completing the test described above, repeat steps 2 and 3 at a vacuum level of approximately 20 inches Hg.
6. Approximately 1 hour after completing the test described above, connect to the deeper screened interval of NMW-11 and repeat steps 2 and 3.

4.5 DATA ANALYSIS AND INTERPRETATION

The rate of mass removal will be estimated using the measured rates of soil vapor and groundwater extraction multiplied by the average or final concentrations of VOCs detected in laboratory samples collected during testing. The rate of mass removal for each vacuum level tested, together with estimated full-scale capital and O&M costs for each test case; will be compared to optimize equipment selection and operating parameters for a full-scale system. Similarly, the ROI in the vadose zone will be estimated for each SVE test vacuum and will be used to optimize SVE wellfield design, equipment selection, and operating parameters. The ROI is estimated as the distance at which a sufficient level of vacuum will be present to induce airflow – typically considered approximately 0.1 inches water or 10 percent of the applied vacuum at the extraction well.

The full-scale vapor treatment system will be designed using the estimated total rate of soil vapor extraction from the proposed extraction wellfield and expected maximum combined concentration of VOCs in the extracted soil vapor. Design will include confirmation of using VPCA and in sizing the VPCA units. Similarly, the estimated total rate of groundwater extraction from the proposed extraction wellfield and expected maximum concentration of VOCs in the extracted groundwater will be used to design the liquid treatment system. Design will include confirmation of using LPCA for treatment and sizing of the LPCA units as well as a comparative economic analysis of possible off-site treatment and disposal. Off-site treatment and disposal may be more cost-effective if the quantities of groundwater extracted are comparatively low.

4.6 REPORTING

A report will be prepared to summarize the results and present the evaluation of the pilot test data, including verification of the suitability of using SVE/MPE to address vadose zone soils and the semi-perched groundwater. The report will also include recommendations for full-scale design, to be used in conjunction with the pre-design site characterization data.

A data report will also be prepared and submitted to SCAQMD to document the performance of the vapor treatment system during testing.

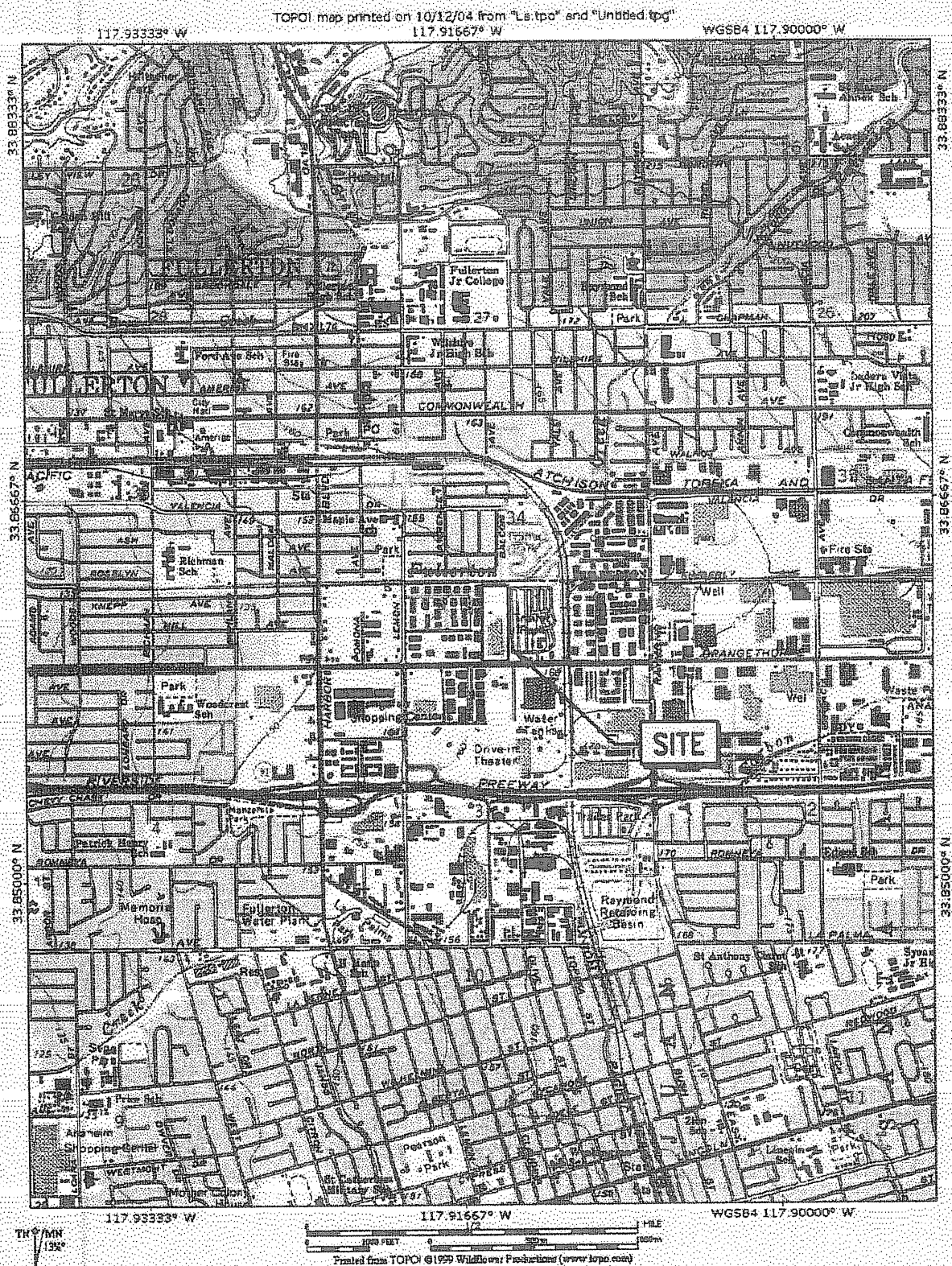
4.7 SCHEDULE

Upon receiving authorization to proceed, field preparation and well permitting can be completed within approximately 3 to 6 weeks. Construction of the new monitoring wells, to be used for pilot testing and likely as part of a full-scale SVE/MPE system, can be completed within approximately 1 to 2 weeks of receiving permits. The pilot test equipment can be mobilized and assembled during this same period. Pilot testing is planned to be conducted within an approximately 3 day period, as detailed in Section 4.4. The summary report can be completed within approximately 2 to 3 weeks after completion of the field testing work and receipt of analytical data.

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FIGURES



**SITE VICINITY MAP
FORMER Y-12 FACILITY
NORTHROP GRUMMAN CORPORATION
ANAHEIM, CALIFORNIA**

URS

TO TO SCALE

CHECKED BY:

DATE: 10-12-04

FIG. NO:

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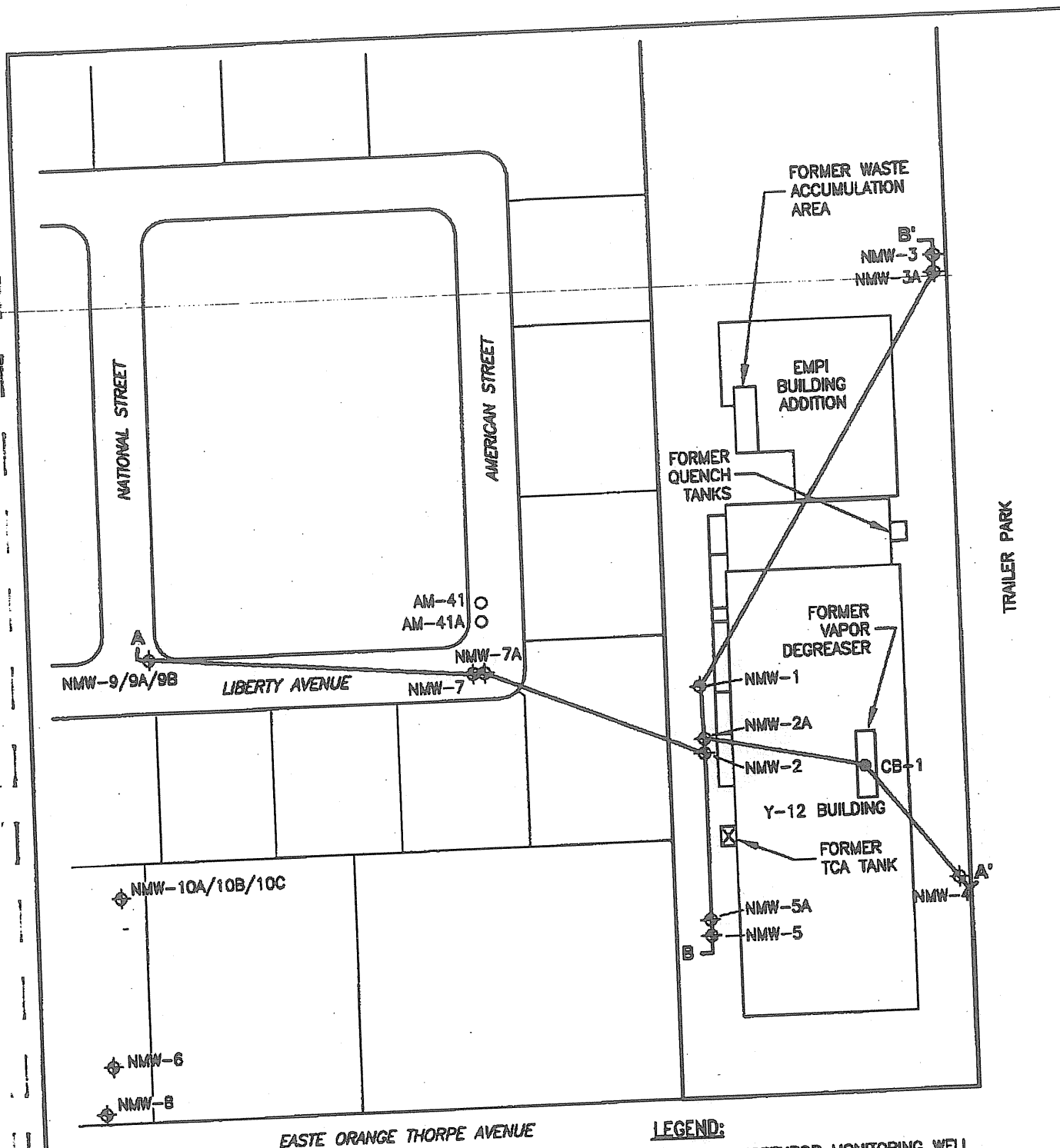
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LEGEND:

- NMW-B NORTHROP MONITORING WELL
- AM-41 OWCD MONITORING WELL
- CB-1 SOIL BORING
- LINE OF CROSS SECTION

**SITE VICINITY WITH WELL LOCATIONS
FORMER Y-12 FACILITY
NORTHROP GRUMMAN CORPORATION
ANAHEIM, CALIFORNIA**



URS

100 0 100 200 Feet
SCALE: 1" = 200'

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FIG. NO:

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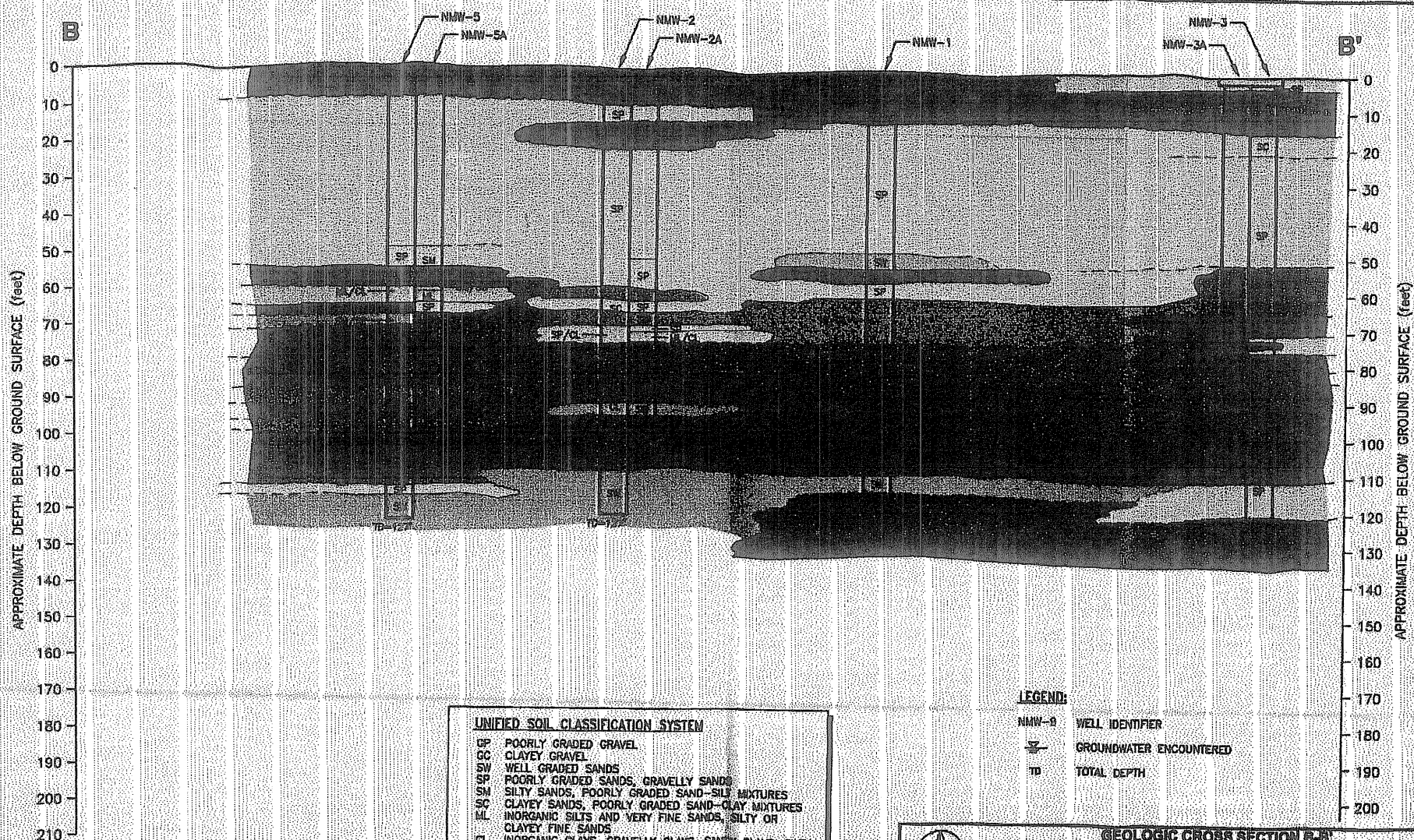
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12.5 0 12.5 25 Feet
 VERTICAL SCALE: 1" = 25'

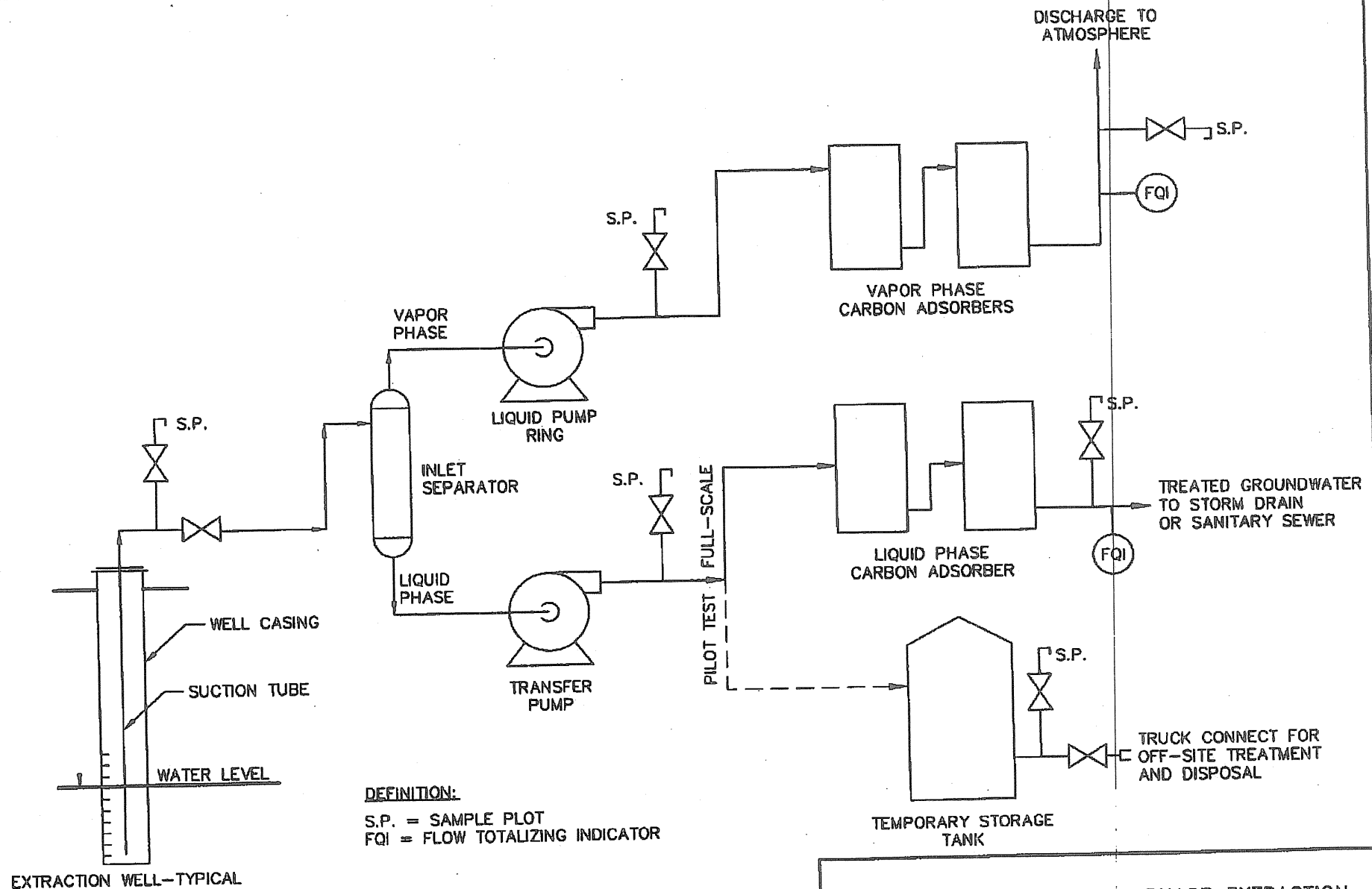
CHECKED BY: DATE: 10-12-04 FIG. NO.
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GEOLOGIC CROSS SECTION B-B'
FORMER Y-12 FACILITY
NORTHROP GRUMMAN CORPORATION
ANAHEIM, CALIFORNIA

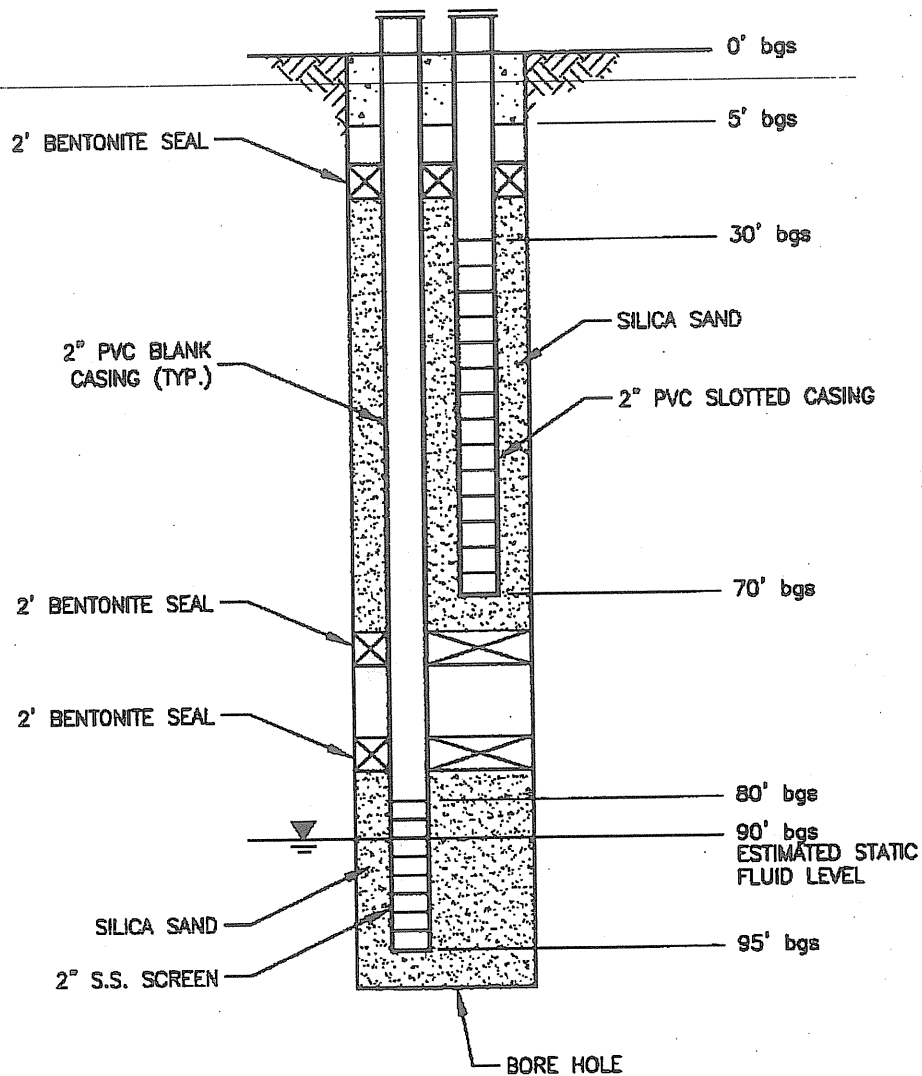
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SCHEMATIC DIAGRAM—TWO PHASE EXTRACTION

URS	CHECKED BY:	DATE: 10-12-04	FIG. NO: 5
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bgs = BELOW GROUND SURFACE

**SVC/MPE WELL SCHEMATIC
TYPICAL x 3 - NMW-11, 12, AND 13
NORTHROP GRUMMAN CORPORATION
ANAHEIM, CALIFORNIA**

URS

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DATE: 10-12-04

FIG. NO:

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PROJ. NO: 27704081.01000

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EICF DOCUMENT CONTROL INFORMATION
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Author Malcolm Pirnie, Inc

Date November 1996

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NGSC36172

**MALCOLM
PIRNIE**

**GROUNDWATER MONITORING REPORT
THIRD QUARTER 1996**

**NORTHROP GRUMMAN CORPORATION
MILITARY AIRCRAFT SYSTEMS DIVISION
FORMER NORTHROP Y-12 FACILITY
301 EAST ORANGETHORPE AVENUE
ANAHEIM, CALIFORNIA**

NOVEMBER 1996

MALCOLM PIRNIE, INC.

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Palo Alto, California**

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White Plains, New York**

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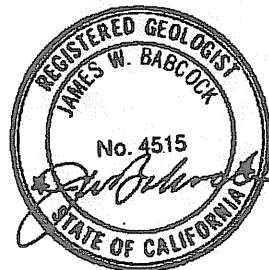
NGSC36173

**MALCOLM
PIRNIE**

**GROUNDWATER MONITORING REPORT
THIRD QUARTER 1996**

**NORTHROP GRUMMAN CORPORATION
MILITARY AIRCRAFT SYSTEMS DIVISION
FORMER NORTHROP Y-12 FACILITY
301 EAST ORANGETHORPE AVENUE
ANAHEIM, CALIFORNIA**

NOVEMBER 1996



MALCOLM PIRNIE, INC.

**3775 Redwood Circle
Palo Alto, California**

**104 Corporate Park Drive
White Plains, New York**

3043-001

NGSC36174

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EXECUTIVE SUMMARY

This is the first quarterly monitoring report since the installation of the groundwater monitoring wells.

Northrop Grumman Corporation (Northrop) formerly owned the property located at 301 East Orangethorpe Avenue, Anaheim, California. The property was leased by Northrop in 1962. The facility, identified as Y-12, was constructed in 1962 and Northrop purchased the property in 1992. Northrop ceased manufacturing and closed the facility in 1994. The property was purchased in early 1996 by EMPI, Inc.

The facility was used by Northrop primarily for the manufacture of floor beams for the Boeing 747 aircraft. The industrial practices at the former Y-12 facility included the use and storage of petroleum products and chlorinated solvents.

During Northrop facility closure activities several environmentally impacted soil areas were remediated. The California Environmental Protection Agency (Cal-EPA) Regional Water Quality Control Board - Santa Ana Region (RWQCB) provided regulatory closure of the soils and requested that Northrop collect groundwater data for the site. Hydropunch samples collected from the uppermost water-bearing zone in September and October 1995 contained detectable concentrations of 1,1-dichloroethene (1,1-DCE), 1,1,1-trichloroethane (1,1,1-TCA), 1,1,2-trichloroethene (1,1,2-TCA), trichloroethene (TCE) and tetrachloroethene (PCE).

The initial groundwater investigation established that the former Y-12 facility was within a regional TCE groundwater plume originating in an area to the east-northeast. Regional groundwater chemical concentrations were shown to decrease as the plume moved past the site. Chemical concentrations of volatile organic compounds (VOCs) in the groundwater collected by the hydropunch method lead the RWQCB to request that Northrop install groundwater monitoring wells at the site.

A total of four groundwater monitoring wells were installed in July and August, 1996. The groundwater elevations were measured in each well and the groundwater flow direction is to the west-southwest, coinciding with the regional groundwater flow direction.

The groundwater monitoring wells were purged, sampled, and the samples submitted to a California certified analytical laboratory. The analytical results of the groundwater samples indicates that the site is being impacted by upgradient sources of VOCs including TCE and toluene. Also, the results indicate the groundwater in the downgradient wells are impacted by VOCs.

1.0 INTRODUCTION

1.1 BACKGROUND

Northrop-Grumman Corporation (Northrop) formerly owned the property located at 301 East Orangethorpe Avenue, Anaheim, California (Figure 1). The property was leased by Northrop in 1962. The facility, identified as Y-12, was constructed in 1962 and Northrop purchased the property in 1992. Northrop ceased manufacturing and closed the facility in 1994. The property was purchased in early 1996 by EMPI, Inc.

The facility was used by Northrop primarily for the manufacture of floor beams for Boeing 747 aircraft. The industrial practices at the former Y-12 facility included the use and storage of petroleum products and chlorinated solvents.

Site investigations indicated that solvents and solvent degradation by-products were present in the subsurface. Hydropunch samples collected from the uppermost water-bearing zone in September and October 1995 contained detectable concentrations of 1,1-dichloroethene (1,1-DCE), 1,1,1-trichloroethane (1,1,1-TCA), 1,1,2-trichloroethene (1,1,2-TCA), trichloroethene (TCE) and tetrachloroethene (PCE).

1.2 PURPOSE AND OBJECTIVES

The purpose of the quarterly groundwater monitoring is to provide groundwater quality data and groundwater flow directions.

The objectives of the groundwater quality monitoring are:

- Confirm the presence of the regional TCE plume at the site.
- Document the upgradient concentrations of VOCs in the uppermost aquifer where the groundwater enters the site.
- Monitor the chemical concentrations in the groundwater over time as the groundwater passes beneath the site.

- Determine the direction of groundwater flow and monitor any changes in the groundwater flow direction.
- Estimate the magnitude of the groundwater hydraulic gradient.
- Report to the California Regional Water Quality Control Board the results of the groundwater monitoring.

1.3 REGIONAL GROUNDWATER

The regional groundwater flow in the upper Talbert Aquifer is documented by a network of groundwater monitoring wells maintained and sampled by the Orange County Water District (OCWD). OCWD manages the groundwater basin of the Coastal Plain in the Orange County area. The regional groundwater occurs at about 110 to 130 feet below ground surface (bgs). Groundwater flow is generally from east-northeast to west-southwest except near the Fullerton Wellfield where groundwater extraction has affected the flow direction.

The groundwater in the Anaheim - Fullerton area has been the subject of an on-going study concerning solvent chemicals in groundwater (OCWD, 1991). This study documents a TCE plume in groundwater extending at least one and one-half miles upgradient of the former Y-12 facility. The OCWD monitoring wells indicate that the chemical concentrations in the TCE plume diminishes downgradient of the site. A more detailed discussion of the regional groundwater issues is included in Malcolm Pirnie (1996).

2.0 GROUNDWATER MONITORING

Groundwater monitoring, using the newly installed monitoring wells at the former Y-12 Facility, began during the last week of August 1996. Depths to groundwater were measured (sounded) and the first round of groundwater quality samples were collected. The following paragraphs present a discussion of the groundwater monitoring methods and results.

2.1 MONITORING WELL LOCATIONS

The horizontal and vertical locations of the new groundwater monitoring wells were surveyed in August 1996 (Table 1). The survey was performed by Towel, Inc., Tustin, California. Horizontal monitoring well locations were established based on the California Coordinate System, B3, Zone VI. Elevations were established based on Orange County Survey Benchmark 404-11-68, elevation 159.207, NGVD-29. The benchmark is located about one-half mile east along the Atchison, Topeka, and Santa Fe Railway. Figure 2 illustrates the monitoring well locations.

TABLE 1				
MONITORING WELL SURVEY INFORMATION				
Monitoring Well	Northing	Easting	Surface Elevation	Measuring Point
NMW-1	2260937.77	6056065.16	159.10	158.45
NMW-2	2260858.51	6056064.39	159.50	158.85
NMW-3	2261402.55	6056359.70	157.24	156.79
NMW-4	2260675.55	6056354.08	160.44	159.95

2.2 DEPTHS TO GROUNDWATER

Depths to groundwater were sounded on August 26, 1996, following development of NMW-4. A Slope Indicator electronic sounder was used to make the depth to water measurements. Groundwater level elevations ranged from 61.25 to 61.89 feet above mean sea level. The hydraulic gradient was to the west-southwest. Figure 2 illustrates the groundwater potentiometric surface at the former Y-12 Facility on August 26, 1996.

2.3 GROUNDWATER QUALITY MONITORING

Groundwater samples were collected from the former Y-12 Facility monitoring wells on August 27, 1996, for analyses to determine the presence of volatile organic compounds (VOCs). The groundwater samples were analyzed using U.S. EPA Method 8240.

The monitoring wells were purged prior to sampling the groundwater. At least three well volumes of groundwater were extracted from the monitoring wells before sampling. Purging was performed by connecting a vacuum truck hose to a dedicated stinger, placed in each well after installation and development. Groundwater was extracted in to a calibrated holding tank on the vacuum truck. Groundwater physical characteristics, pH, temperature, and conductivity, were monitored through sampling ports on the temporary holding tank. The groundwater samples were bailed after the physical characteristics had stabilized. The field collection parameters are record on groundwater sampling forms included in Appendix A.

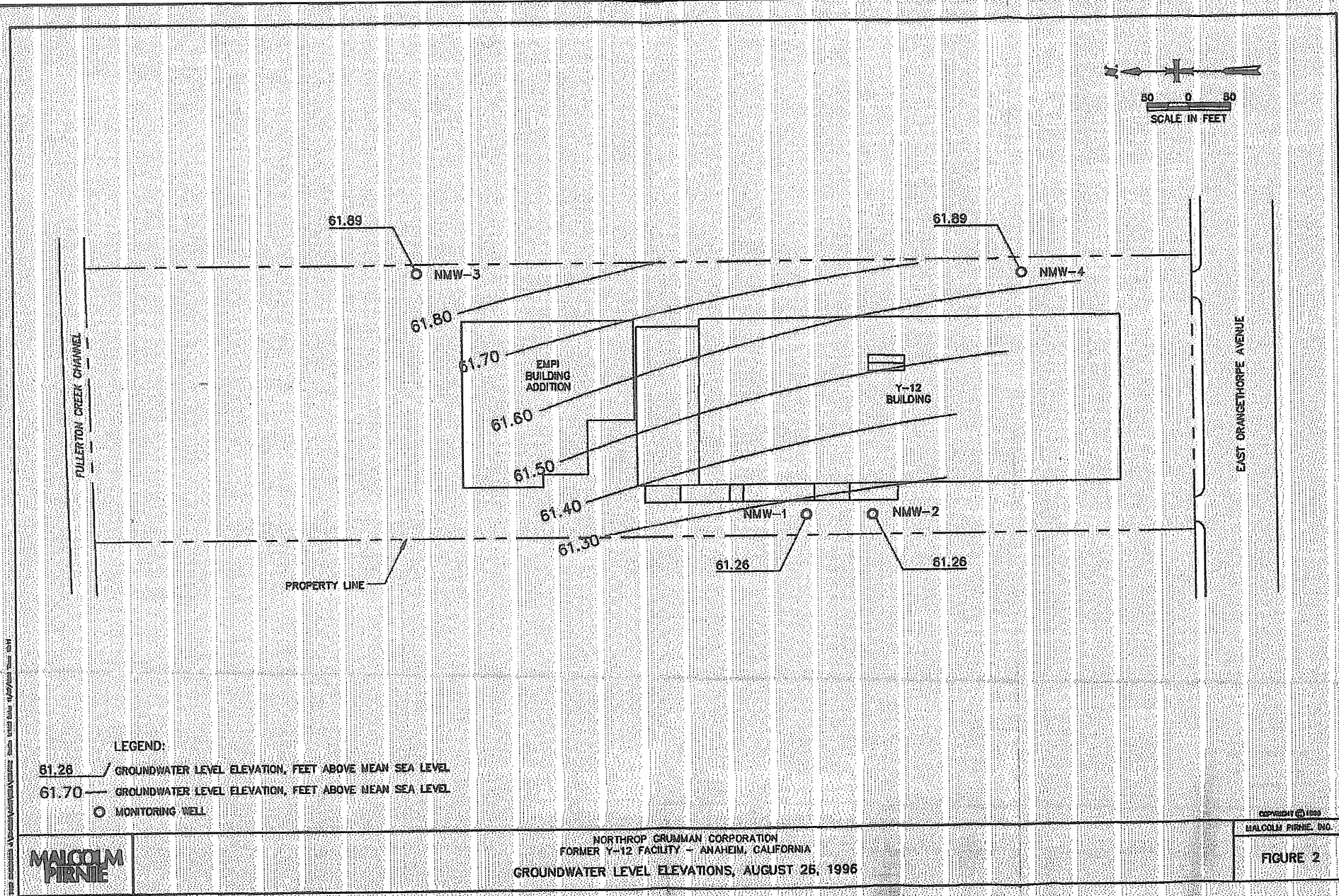
The bailed groundwater samples were dispensed into 40 ML VOA vials, then stored in an iced cooler at 4° C. The groundwater samples and a trip blank were delivered to Calscience Environmental Laboratories, Inc., Garden Grove, California, a California state certified environmental laboratory, for analyses.

The analytical results from the August 27, 1996 sampling event are the first samples to be collected using complete U.S. EPA groundwater sampling protocols. The groundwater samples were analyzed by U.S. EPA Method 8240. The analytical results are presented in

Table 2 and summarized in Figure 3. Copies of the laboratory reports are included in Appendix A.

TABLE 2							
GROUNDWATER ANALYTICAL RESULTS							
Monitoring Well	Groundwater Analytical Results						
	TCE	1,1,1-TCA	PCE	1,1-DCA	1,1,2-TCA	Toluene	Chloroform
NMW-1	31 μ g/L	ND	3 μ g/L	ND	ND	ND	ND
NMW-2	869 μ g/L	117 μ g/L	82 μ g/L	3 μ g/L	2 μ g/L	2 μ g/L	1 μ g/L
NMW-3	162 μ g/L	ND	ND	ND	ND	15 μ g/L	ND
NMW-4	6 μ g/L	ND	ND	ND	ND	11 μ g/L	ND

Note: ND = Non-Detect



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NORTHROP GRUMMAN CORPORATION
FORMER Y-12 FACILITY - ANAHEIM, CALIFORNIA
GROUNDWATER LEVEL ELEVATIONS, AUGUST 26, 1996

FIGURE 2



7403 3043001003 J 3043001 \ACAD\QUARTER 951E1 Scale: 1:11 Date: 11/07/1998 Time: 16:34

1000 0 1000
SCALE IN FEET

REFERENCE: 7.5' USGS
TOPOGRAPHIC MAP,
ANAHEIM, CALIFORNIA
DATED 1965 (REV. 1981)

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NORTHROP GRUMMAN CORPORATION
FORMER Y-12 FACILITY - ANAHEIM, CALIFORNIA

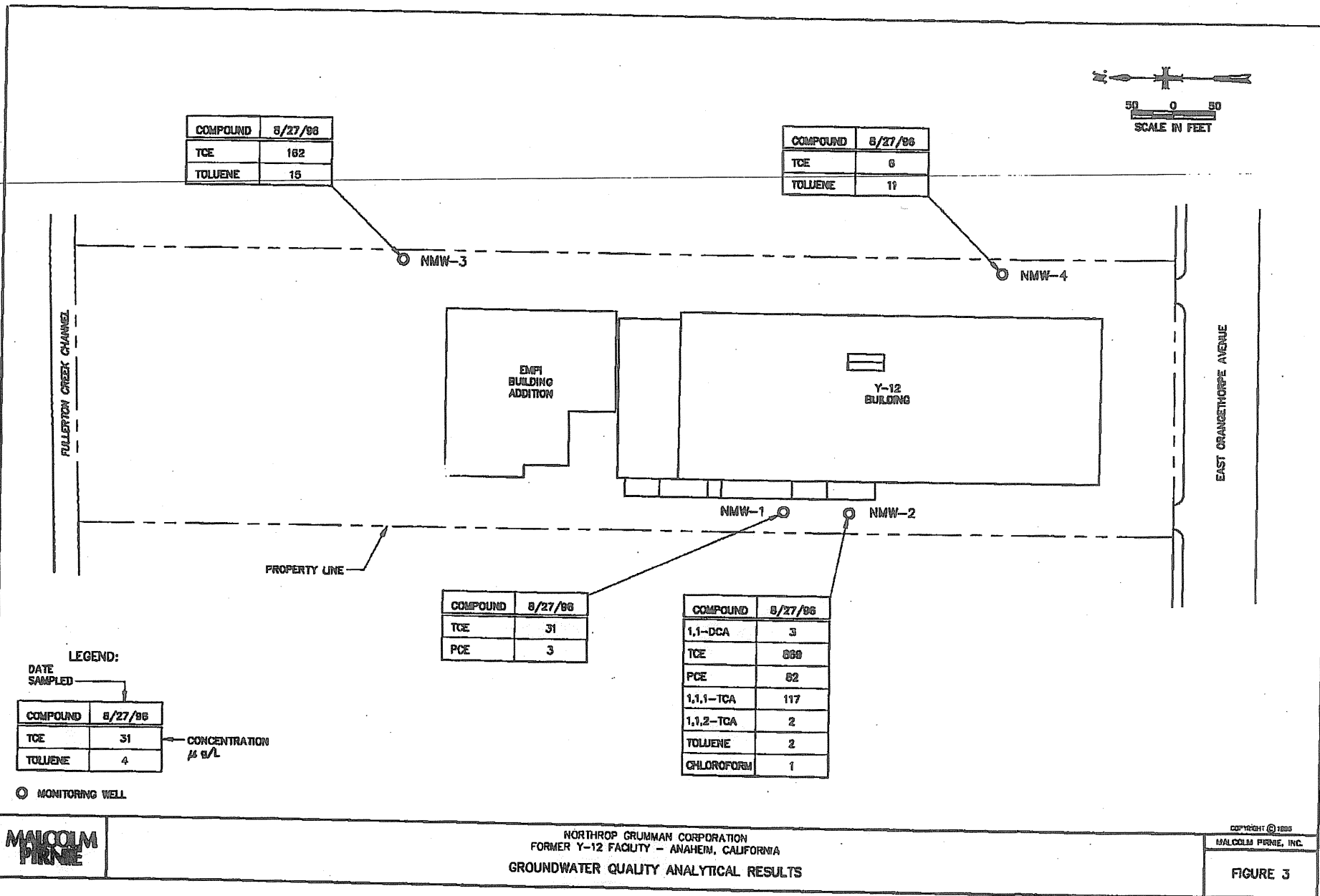
SITE LOCATION MAP

MALCOLM PIRNIE, INC.

FIGURE 1

NGSC36184

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3.0 REFERENCES

Malcolm Pirnie, Inc., 1996, *Monitoring Well Installation Report*. Prepared for Northrop Grumman Corporation, Military Aircraft System Division, November.

Orange County Water District, 1984, *Ground Water Management, Irvine Area, Orange County, CA*. Prepared by Harvey O. Banks, Consulting Engineer, Inc., September 1984.

Orange County Water District, 1991, *Phase I Hydrogeologic Investigation of Chlorinated VOC Contamination in the Anaheim/Fullerton Area*. May 1991.

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A

A

RECYCLED PAPER

NGSC36187

APPENDIX A

Groundwater Sampling Forms

3043-001

NGSC36188

GROUNDWATER SAMPLING FORM

MacDonald & Associates
32285 Crooked Arrow Drive
Lake Elsinore, California 92532
(909) 245-2525

Well Number: NMW - 1		Job Name: Northrop	
Well Type: Monitor: X		Extraction:	
Other:		Job Number: unavailable	
Well Materials: PVC: X		Stainless Steel:	
Other:		Recorded By: Mattie A. MacDonald	
Sampled By: Mattie A. MacDonald		Date of Sampling Event: August 27, 1996	
Time of Well Elevation Measurement: 9:09			
WELL PURGING DATA		PURGE METHOD	
Casing Diameter (Diameter in inches):		Bailer Type:	
2-inches X 4-inches 6-inches Other		Submersible: Centrifugal: Bladder:	
Total Depth of Casing (in feet): 125.00		Vacuum Truck: ISLAND ENVIRONMENTAL	
Depth to Free Product: NA		Purging Location:	
Depth to Groundwater: 97.42		Near Top: X Near Bottom: Other:	
Well Condition: good condition ✓			
Ground Cover Locked: X Yes No			
Casing Cover Locked: Yes X No			
PURGE VOLUME CALCULATION			
$(125 - 97.42) \times (1.75) \times (0.67) \times (1.75) \times 3 = 55.44$			
(TD feet)	(WL feet)	RATIO	NO OF VOLUMES
TOTAL GALLONS PURGED: 60			
FIELD PARAMETER MEASUREMENTS			
Start: 11:20	Stop: 11:33	Elapsed: 33	Initial gpm: 2.5 Average gpm: 1.8
Parameter Meter Used: HORIBA		Groundwater Probe: Solist	
		Turbidity: Lamotte	
Gallons Purged	pH	Temperature C°	Conductivity Dissolved Oxygen Turbidity (If Required)
START	7.68	24.0	123 9.55 cloudy
10 10	7.68	21.9	1.32 11.28 cloudy
20 20	7.64	21.7	0.981 12.38 clear
30 30	7.63	21.4	0.994 12.89 clear
40 40	7.63	21.2	0.986 13.26 clear
50 50	7.62	21.4	0.986 13.97 clear
60 60	7.62	21.2	0.995 13.53 clear
70	ph units	celcius	ms/cm mg/l
80			
90			
100			
Observations during purging (Well Condition, Turbidity, Color, Odor): NO odor			
Disposal Company: Demenn Kerdoon Handled by Island Environmental			
SAMPLING DATA			
Bailer: Disposable	Submersible:	Centrifugal:	Bladder:
Grab Sample:	Other:		
Duplicate Sample Taken: MW-00 =			

GROUNDWATER SAMPLING FORM

MacDonald & Associates
32285 Crooked Arrow Drive
Lake Elsinore, California 92532
(909) 245-2525

Well Number: NMW - 2		Job Name: Northrop	
Well Type: Monitor: X	Extraction:	Job Number: unavailable	
Other:		Recorded By: Mattie A. MacDonald	
Well Materials: PVC: X	Stainless Steel:	Sampled By: Mattie A. MacDonald	
Other:		Date of Sampling Event: August 27, 1996	
		Time of Well Elevation Measurement: 9:03	
WELL PURGING DATA		PURGE METHOD	
Casing Diameter (Diameter in inches):		Bailer Type:	
2-Inches X 4-inches 6-inches Other		Submersible: Centrifugal: Bladder:	
Total Depth of Casing (in feet): 1250		Vacuum Truck: ISLAND ENVIRONMENTAL	
Depth to Free Product: NA		Purging Location:	
Depth to Groundwater: 97.85		Near Top: X Near Bottom: Other:	
Well Condition: good condition			
Ground Cover Locked: X Yes No			
Casing Cover Locked: Yes No			
PURGE VOLUME CALCULATION			
$(125 - 97.85) \times (1.75) \left(\frac{.67}{.175} \right) \times 3 = 54.57 \text{ TOTAL}$			
(TD feet)	(WL feet)	RATIO	NO OF GALLONS VOLUMES
TOTAL GALLONS PURGED: 60			
FIELD PARAMETER MEASUREMENTS			
Start: 10:10	Stop: 10:40	Elapsed: 30	Initial gpm: 3 Average gpm: 2
Parameter Meter Used: HORIBA	Groundwater Probe: Solist	Turbidity: Lamotte	
Gallons Purged	pH	Temperature °C	Conductivity Dissolved Oxygen Turbidity (If Required)
START	7.27	27.8	1.45 9.47 clear
10	7.79	23.0	1.27 10.46 mg/L slightly cloudy
1020	7.40	21.4	1.25 10.31 " " "
1530	7.77	21.2	1.26 9.98 clear
2040	7.79	21.0	1.27 9.99 clear
2550	7.72	20.8	1.27 9.60 clear
3060	7.77	20.6	1.27 9.62 clear
35	ph units	°C	mg/L
40			
50			
60			
Observations during purging (Well Condition, Turbidity, Color, Odor): no odor throughout			
Disposal Company: Demenn Kerdoon Handled by Island Environmental			
SAMPLING DATA			
Bailer: Disposable	Submersible:	Centrifugal:	Bladder:
Grab Sample:	Other:		
Duplicate Sample Taken: MW-00 =			

GROUNDWATER SAMPLING FORM

MacDonald & Associates

32285 Crooked Arrow Drive

Lake Elsinore, California 92532

(909) 245-2525

Well Number: NMW - 3		Job Name: Northrop	
Well Type: Monitor: X Extraction:		Job Number: unavailable	
Other:		Recorded By: Mattie A. MacDonald	
Well Materials: PVC: X Stainless Steel:		Sampled By: Mattie A. MacDonald	
Other:		Date of Sampling Event: August 27, 1996	
		Time of Well Elevation Measurement: 9:33	
WELL PURGING DATA		PURGE METHOD	
Casing Diameter (Diameter in inches):		Bailer Type:	
2-Inches X 4-inches 6-inches Other		Submersible: Centrifugal: Bladder:	
Total Depth of Casing (in feet): 129.00		Vacuum Truck: ISLAND ENVIRONMENTAL	
Depth to Free Product: NA		Purging Location:	
Depth to Groundwater: 95.13		Near Top: X Near Bottom: Other:	
Well Condition: good condition ✓			
Ground Cover Locked: X Yes No			
Casing Cover Locked: Yes X No			
PURGE VOLUME CALCULATION			
$(129 - 95.13) \times (1.75) / (.67) / (.175) \times 3 = 58.03 \text{ TOTAL GALLONS}$			
(TD feet) (WL feet) RATIO NO OF VOLUMES			
TOTAL GALLONS PURGED: 160			
FIELD PARAMETER MEASUREMENTS			
Start: 12:00 Stop: 12:39 Elapsed: 39		Initial gpm: 2.5 Average gpm: 1.5	
Parameter Meter Used: HORIBA Groundwater Probe: Solist		Turbidity: Lamotte	
Gallons Purged	pH	Temperature	Conductivity Dissolved Oxygen Turbidity (If Required)
START	8.00	30.7	1.05 11.11 Muddy
10 10	7.74	28.1	1.34 14.41 muddy
20 20	7.72	22.9	1.34 14.53 cloudy
30 30	7.69	23.4	1.36 14.36 clear
40 40	7.68	22.8	1.36 14.41 clear
50 50	7.68	22.1	1.36 14.66 clear
60 60	7.66	22.0	1.37 15.48 clear
35			
40			
50			
60			
Observations during purging (Well Condition, Turbidity, Color, Odor): / no odor throughout			
Mixed up after about 30 gals. / purging			
Disposal Company: Demann Kerdoon Handled by Island Environmental			
SAMPLING DATA			
Bailer: Disposable Submersible:		Centrifugal: Bladder:	
Grab Sample:		Other:	
Duplicate Sample Taken: MW-00 =			

NGSC36191

GROUNDWATER SAMPLING FORM

MacDonald & Associates
32285 Crooked Arrow Drive
Lake Elsinore, California 92532
(909) 245-2525

Well Number: NMW - 4		Job Name: Northrop	
Well Type: Monitor: X		Extraction:	
Other:		Job Number: unavailable	
Well Materials: PVC: X		Stainless Steel:	
Other:		Recorded By: Mattie A. MacDonald	
		Sampled By: Mattie A. MacDonald	
		Date of Sampling Event: August 27, 1996	
		Time of Well Elevation Measurement: 9:17	
WELL PURGING DATA		PURGE METHOD	
Casing Diameter (Diameter in inches):		Bailer Type:	
2-Inches X 4-Inches 6-Inches Other		Submersible: Centrifugal: Bladder:	
Total Depth of Casing (in feet): 130.00		Vacuum Truck: ISLAND ENVIRONMENTAL	
Depth to Free Product: NA		Purging Location:	
Depth to Groundwater: 98.40		Near Top: X Near Bottom: Other:	
Well Condition: good condition ✓			
Ground Cover Locked: X Yes No			
Casing Cover Locked: Yes X No			
PURGE VOLUME CALCULATION			
$(130 - 98.40) \times (1.75) \times (1.67) \times 3 = 163.52$			
(TD feet)	(WL feet)	RATIO	NO OF VOLUMES
TOTAL GALLONS PURGED: 65			
FIELD PARAMETER MEASUREMENTS			
Start: 12:56 Stop: 1:31		Elapsed: 35	
Parameter Meter Used: HORIBA		Groundwater Probe: Solist	
Gallons Purged		Turbidity: Lamotte	
pH	Temperature	Conductivity	Dissolved Oxygen
Turbidity (If Required)			
START	8.15	25.5	1.41
8 10	7.97	23.4	1.35
10 20	7.95	22.5	1.28
18 30	7.96	22.0	1.24
20 40	7.92	22.0	1.25
25 50	7.96	21.9	0.897
30 60	7.88	21.7	0.857
35 70	7.88	21.5	0.886
40			
50			
60			
Observations during purging (Well Condition, Turbidity, Color, Odor): NO odor			
Disposal Company: Demenn Kerdoon Handled by Island Environmental			
SAMPLING DATA			
Bailer: Disposable	Submersible:	Centrifugal:	Bladder:
Grab Sample:	Other:		
Duplicate Sample Taken: MW-00 =			

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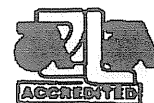
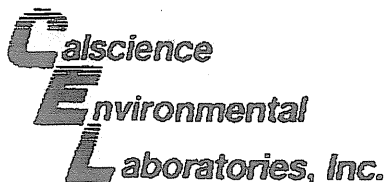
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APPENDIX B

Certified Analytical Reports

3043-001

NGSC36194



September 05, 1996

Jim Babcock

Malcolm Pirnie, Inc.
3775 Repwood Circle
Palo Alto, CA 94306

Subject: Calscience Work Order Number: 96-08-503
Client Reference: Northrop - 301 E. Orangethorpe

Dear Client:

Enclosed is an analytical report for the above-referenced project. The samples included in this report were received 08/27/96 and analyzed in accordance with the attached chain-of-custody.

The results in this analytical report are limited to the samples tested, and any reproduction of this report must be made in its entirety.

If you have any questions regarding this report, require sampling supplies or field services, or information on our analytical services, please feel free to call me at (714) 895-5494.

Sincerely,

Calscience Environmental
Laboratories, Inc.
Tori Arnold
Project Manager

William H. Christensen
Deliverables Manager



Malcom Pimie, Inc.
3775 Redwood Circle
Palo Alto, CA 94306

Date Sampled: 08/27/96
Date Received: 08/27/96
Date Extracted: P/T
Date Analyzed: 09/04/96
Work Order No.: 96-08-503
Method: EPA 8240B

Attn: Jim Babcock
RE: Northrop-301 E. Orangethorpe

Page 1 of 5

All concentrations are reported in µg/L (ppb).

Sample Number: NMW-1

Analyte	Conc	Reportable Limit	Analyte	Conc	Reportable Limit
Acetone	ND	25	Cis-1,2-Dichloroethene	ND	1
Benzene	ND	1	Trans-1,2-Dichloroethene	ND	1
Bromodichloromethane	ND	1	1,2-Dichloropropane	ND	1
Bromoform	ND	1	Cis-1,3-Dichloropropene	ND	1
Bromomethane	ND	2	Trans-1,3-Dichloropropene	ND	1
2-Butanone	ND	25	Ethylbenzene	ND	1
Carbon Disulfide	ND	1	2-Hexanone	ND	2
Carbon Tetrachloride	ND	1	Methylene Chloride	ND	10
Chlorobenzene	ND	1	4-Methyl-2-Pentanone	ND	2
Chloroethane	ND	1	Styrene	ND	1
2-Chloroethyl Vinyl Ether	ND	1	1,1,2,2-Tetrachloroethane	ND	1
Chloroform	ND	1	Tetrachloroethene	3	1
Chloromethane	ND	1	Toluene	ND	1
Dibromochloromethane	ND	1	1,1,1-Trichloroethane	ND	1
1,2-Dichlorobenzene	ND	1	1,1,2-Trichloroethane	ND	1
1,3-Dichlorobenzene	ND	1	Trichloroethene	31	1
1,4-Dichlorobenzene	ND	1	Trichlorofluoromethane	ND	5
Dichlorodifluoromethane	ND	1	Vinyl Acetate	ND	1
1,1-Dichloroethane	ND	1	Vinyl Chloride	ND	1
1,2-Dichloroethane	ND	1	Total Xylenes	ND	2
1,1-Dichloroethene	ND	1			

Malcom Pirnie, Inc.
3775 Redwood Circle
Palo Alto, CA 94306

Date Sampled: 08/27/96
Date Received: 08/27/96
Date Extracted: P/T
Date Analyzed: 09/04/96
Work Order No.: 96-08-503
Method: EPA 8240B
Page 2 of 5

Attn: Jim Babcock
RE: Northrop-301 E. Orangethorpe

All concentrations are reported in µg/L (ppb).

Sample Number: NMW-2

<u>Analyte</u>	<u>Conc</u>	<u>Reportable Limit</u>	<u>Analyte</u>	<u>Conc</u>	<u>Reportable Limit</u>
Acetone	ND	25	Cis-1,2-Dichloroethene	ND	1
Benzene	ND	1	Trans-1,2-Dichloroethene	ND	1
Bromodichloromethane	ND	1	1,2-Dichloropropane	ND	1
Bromoform	ND	1	Cis-1,3-Dichloropropene	ND	1
Bromomethane	ND	2	Trans-1,3-Dichloropropene	ND	1
2-Butanone	ND	25	Ethylbenzene	ND	1
Carbon Disulfide	ND	1	2-Hexanone	ND	2
Carbon Tetrachloride	ND	1	Methylene Chloride	ND	10
Chlorobenzene	ND	1	4-Methyl-2-Pentanone	ND	2
Chloroethane	ND	1	Styrene	ND	1
2-Chloroethyl Vinyl Ether	ND	1	1,1,2,2-Tetrachloroethane	ND	1
Chloroform	1	1	Tetrachloroethene	82	1
Chloromethane	ND	1	Toluene	2	1
Dibromochloromethane	ND	1	1,1,1-Trichloroethane	117	1
1,2-Dichlorobenzene	ND	1	1,1,2-Trichloroethane	2	1
1,3-Dichlorobenzene	ND	1	Trichloroethene	869	20
1,4-Dichlorobenzene	ND	1	Trichlorofluoromethane	ND	5
Dichlorodifluoromethane	ND	1	Vinyl Acetate	ND	1
1,1-Dichloroethane	3	1	Vinyl Chloride	ND	1
1,2-Dichloroethane	ND	1	Total Xylenes	ND	2
1,1-Dichloroethene	ND	1			



Malcom Pirnie, Inc.
3775 Redwood Circle
Palo Alto, CA 94306

Date Sampled: 08/27/96
Date Received: 08/27/96
Date Extracted: P/T
Date Analyzed: 09/04/96
Work Order No.: 96-08-503
Method: EPA 8240B

Attn: Jim Babcock
RE: Northrop-301 E. Orangethorpe

Page 3 of 5

All concentrations are reported in µg/L (ppb).

Sample Number: NMW-3

Analyte	Conc	Reportable Limit	Analyte	Conc	Reportable Limit
Acetone	ND	25	Cis-1,2-Dichloroethene	ND	1
Benzene	ND	1	Trans-1,2-Dichloroethene	ND	1
Bromodichloromethane	ND	1	1,2-Dichloropropane	ND	1
Bromoform	ND	1	Cis-1,3-Dichloropropene	ND	1
Bromomethane	ND	2	Trans-1,3-Dichloropropene	ND	1
2-Butanone	ND	25	Ethylbenzene	ND	1
Carbon Disulfide	ND	1	2-Hexanone	ND	2
Carbon Tetrachloride	ND	1	Methylene Chloride	ND	10
Chlorobenzene	ND	1	4-Methyl-2-Pentanone	ND	2
Chloroethane	ND	1	Styrene	ND	1
2-Chloroethyl Vinyl Ether	ND	1	1,1,2,2-Tetrachloroethane	ND	1
Chloroform	ND	1	Tetrachloroethene	ND	1
Chloromethane	ND	1	Toluene	15	1
Dibromochloromethane	ND	1	1,1,1-Trichloroethane	ND	1
1,2-Dichlorobenzene	ND	1	1,1,2-Trichloroethane	ND	1
1,3-Dichlorobenzene	ND	1	Trichloroethene	162	1
1,4-Dichlorobenzene	ND	1	Trichlorofluoromethane	ND	5
Dichlorodifluoromethane	ND	1	Vinyl Acetate	ND	1
1,1-Dichloroethane	ND	1	Vinyl Chloride	ND	1
1,2-Dichloroethane	ND	1	Total Xylenes	ND	2
1,1-Dichloroethene	ND	1			

Malcom Pimie, Inc.
3775 Redwood Circle
Palo Alto, CA 94306

Date Sampled: 08/27/96
Date Received: 08/27/96
Date Extracted: P/T
Date Analyzed: 09/04/96
Work Order No.: 96-08-503
Method: EPA 8240B
Page 4 of 5

Attn: Jim Babcock
RE: Northrop-301 E. Orangethorpe

All concentrations are reported in µg/L (ppb).

Sample Number: NMW-4

Analyte	Conc	Reportable Limit	Analyte	Conc	Reportable Limit
Acetone	ND	25	Cis-1,2-Dichloroethene	ND	1
Benzene	ND	1	Trans-1,2-Dichloroethene	ND	1
Bromodichloromethane	ND	1	1,2-Dichloropropane	ND	1
Bromoform	ND	1	Cis-1,3-Dichloropropene	ND	1
Bromomethane	ND	2	Trans-1,3-Dichloropropene	ND	1
2-Butanone	ND	25	Ethylbenzene	ND	1
Carbon Disulfide	ND	1	2-Hexanone	ND	2
Carbon Tetrachloride	ND	1	Methylene Chloride	ND	10
Chlorobenzene	ND	1	4-Methyl-2-Pentanone	ND	2
Chloroethane	ND	1	Styrene	ND	1
2-Chloroethyl Vinyl Ether	ND	1	1,1,2,2-Tetrachloroethane	ND	1
Chloroform	ND	1	Tetrachloroethane	ND	1
Chloromethane	ND	1	Toluene	11	1
Dibromochloromethane	ND	1	1,1,1-Trichloroethane	ND	1
1,2-Dichlorobenzene	ND	1	1,1,2-Trichloroethane	ND	1
1,3-Dichlorobenzene	ND	1	Trichloroethene	6	1
1,4-Dichlorobenzene	ND	1	Trichlorofluoromethane	ND	5
Dichlorodifluoromethane	ND	1	Vinyl Acetate	ND	1
1,1-Dichloroethane	ND	1	Vinyl Chloride	ND	1
1,2-Dichloroethane	ND	1	Total Xylenes	ND	2
1,1-Dichloroethene	ND	1			



Malcom Pirnie, Inc.
3775 Redwood Circle
Palo Alto, CA 94306

Date Sampled: 08/27/96
Date Received: 08/27/96
Date Extracted: P/T
Date Analyzed: 09/03/96
Work Order No.: 96-08-503
Method: EPA 8240B
Page 5 of 5

Attn: Jim Babcock
RE: Northrop-301 E. Orangethorpe

All concentrations are reported in µg/L (ppb).

Sample Number: Method Blank

Analyte	Conc	Reportable Limit	Analyte	Conc	Reportable Limit
Acetone	ND	25	Cis-1,2-Dichloroethane	ND	1
Benzene	ND	1	Trans-1,2-Dichloroethane	ND	1
Bromodichloromethane	ND	1	1,2-Dichloropropane	ND	1
Bromoform	ND	1	Cis-1,3-Dichloropropene	ND	1
Bromomethane	ND	2	Trans-1,3-Dichloropropene	ND	1
2-Butanone	ND	25	Ethylbenzene	ND	1
Carbon Disulfide	ND	1	2-Hexanone	ND	2
Carbon Tetrachloride	ND	1	Methylene Chloride	ND	10
Chlorobenzene	ND	1	4-Methyl-2-Pentanone	ND	2
Chloroethane	ND	1	Styrene	ND	1
2-Chloroethyl Vinyl Ether	ND	1	1,1,2,2-Tetrachloroethane	ND	1
Chloroform	ND	1	Tetrachloroethane	ND	1
Chloromethane	ND	1	Toluene	ND	1
Dibromochloromethane	ND	1	1,1,1-Trichloroethane	ND	1
1,2-Dichlorobenzene	ND	1	1,1,2-Trichloroethane	ND	1
1,3-Dichlorobenzene	ND	1	Trichloroethene	ND	1
1,4-Dichlorobenzene	ND	1	Trichlorofluoromethane	ND	5
Dichlorodifluoromethane	ND	1	Vinyl Acetate	ND	1
1,1-Dichloroethane	ND	1	Vinyl Chloride	ND	1
1,2-Dichloroethane	ND	1	Total Xylenes	ND	2
1,1-Dichloroethene	ND	1			

ND denotes not detected at indicated reportable limit.

Each sample was received by CEL chilled, intact, and with chain-of-custody attached.

QUALITY ASSURANCE SUMMARY
Method EPA 8240B

Malcom Pirnie, Inc.

Work Order No.:

96-08-503

Page 1 of 1

Date Analyzed:

08/29/96

Matrix Spike/Matrix Spike Duplicate

Sample Spiked: 96-08-397-1

<u>Analyte</u>	<u>MS%REC</u>	<u>MSD%REC</u>	<u>Control Limits</u>	<u>%RPD</u>	<u>Control Limits</u>
Benzene	103	104	37 - 151	1	0 - 25
Chlorobenzene	102	102	37 - 160	0	0 - 25
Toluene	101	98	47 - 150	3	0 - 25
1,1-Dichloroethene	103	102	D - 234	1	0 - 25
Trichloroethene	112	119	71 - 157	6	0 - 25

Surrogate Recoveries (in %)

<u>Sample Number</u>	<u>S1</u>	<u>S2</u>	<u>S3</u>
NMW-1	96	99	99
NMW-2	96	98	98
NMW-3	96	99	97
NMW-4	96	99	97
Method Blank	98	99	97

Surrogate Compound

Water %REC
Acceptable Limits

Soil %REC
Acceptable Limits

S1 > 1,2-Dichloroethane-d4
S2 > Toluene-d8
S3 > 1,4-Bromofluorobenzene

76 - 114
88 - 110
86 - 115

70 - 121
81 - 117
74 - 121

**CALSCIENCE ENVIRONMENTAL
LABORATORIES, INC.**

7440 LINCOLN WAY
GARDEN GROVE, CA 92641-1432
TEL: (714) 895-5494 • FAX: (714) 894-7501

237

CHAIN OF CUSTODY RECORD

Date 8/9/96
Page 1 of 1

LABORATORY CLIENT: MALCOLM PIRNIE, INC.		CLIENT PROJECT NAME / NUMBER: NORTHROP 4-12	
ADDRESS: 3775 REPWOOD CIRCLE		PROJECT CONTACT: J.W. BABCOCK	
CITY PALO ALTO	STATE CA	ZIP 94306	
TEL: 415-843-1701	FAX: 415-494-2755		
SAMPLER(S): (SIGNATURE) <i>Walter Hernandez</i>			

TURNAROUND TIME:

☐ SAME DAY (≤ 6 HR)², 125% ☐ 24 HOURS, 100% ☒ 48 HOURS, 50% ☐ 72 HOURS³, 25% ☐ 5 DAYS ☐ 10 DAYS ☐ RUSH WRITTEN REPORT, 10%

1. All turnaround times are based on working hours of 8:30 a.m. - 5:30 p.m., M - F. 2. Prior approval is required. 3. Surcharge does not apply to Tedlar bag samples.

SPECIAL INSTRUCTIONS/REQUIREMENTS:

Analyze Trip Blank for EPA 8020 (BT6X). per Mattie 08/12/96.

☐ ROUTINE QC
MS, MS/MSD, Surrogates,
LCS as applicable.

☐ RWQCB Report Format
Surcharge applies

SAMPLE ID	LOCATION/DESCRIPTION	SAMPLING		WATER		AIR		DILUT/ SOL/ FILTER	NO. OF Containers	ANALYSES REQUIRED
		DATE	TIME	Comp.	Grab	Intg.	Grab			
NMW-1		8/9/96	10:55		X				3	8240
NMW-2			10:25		X				3	↓
Trip Blank										

Relinquished by: (Signature) <i>Walter Hernandez</i>	Received by: (Signature)	Date: <u>8/12/96</u>	Time: <u>11:20</u>
Relinquished by: (Signature)	Received by: (Signature)	Date:	Time:
Relinquished by: (Signature)	Received for Laboratory by: (Signature) <i>Joe Rannarain</i>	Date: <u>8/12/96</u>	Time: <u>1120</u>

Unless otherwise requested, all samples will be disposed of 30 days after receipt.

11/01/95 Revision

NGSC36202

Q&Q Graphic (714) 894-9702

Malcolm-Pimie, Inc.
3775 Redwood Circle
Palo Alto, CA 94306

Date Sampled: 08/09/96
Date Received: 08/12/96
Date Extracted: P/T
Date Analyzed: 08/13/96
Work Order No.: 96-08-237
Method: EPA 8240B
Page 1 of 3

Attn: Jim Babcock
RE: Northrop Y-12

All concentrations are reported in µg/L (ppb).

Sample Number: NMW-1

Analyte	Conc	Reportable Limit	Analyte	Conc	Reportable Limit
Acetone	ND	5	Cis-1,2-Dichloroethene	ND	1
Benzene	ND	1	Trans-1,2-Dichloroethene	ND	1
Bromodichloromethane	ND	1	1,2-Dichloropropane	ND	1
Bromoform	ND	1	Cis-1,3-Dichloropropene	ND	1
Bromomethane	ND	2	Trans-1,3-Dichloropropene	ND	1
2-Butanone	ND	2	Ethylbenzene	ND	1
Carbon Disulfide	ND	1	2-Hexanone	ND	2
Carbon Tetrachloride	ND	1	Methylene Chloride	ND	1
Chlorobenzene	ND	1	4-Methyl-2-Pentanone	ND	2
Chloroethane	ND	1	Styrene	ND	1
2-Chloroethyl Vinyl Ether	ND	1	1,1,2,2-Tetrachloroethane	ND	1
Chloroform	ND	1	Tetrachloroethene	4	1
Chloromethane	ND	1	Toluene	ND	1
Dibromochloromethane	ND	1	1,1,1-Trichloroethane	ND	1
1,2-Dichlorobenzene	ND	1	1,1,2-Trichloroethane	ND	1
1,3-Dichlorobenzene	ND	1	Trichloroethane	31	1
1,4-Dichlorobenzene	ND	1	Trichlorofluoromethane	ND	1
Dichlorodifluoromethane	ND	1	Vinyl Acetate	ND	1
1,1-Dichloroethane	ND	1	Vinyl Chloride	ND	1
1,2-Dichloroethane	ND	1	Total Xylenes	ND	2
1,1-Dichloroethene	ND	1			

Malcolm-Pirnie, Inc.
3775 Redwood Circle
Palo Alto, CA 94306

Date Sampled: 08/09/96
Date Received: 08/12/96
Date Extracted: P/T
Date Analyzed: 08/13/96
Work Order No.: 96-08-237
Method: EPA 8240B
Page 2 of 3

Attn: Jim Babcock
RE: Northrop Y-12

All concentrations are reported in µg/L (ppb).

Sample Number: NMW-2

Analyte	Conc	Reportable Limit	Analyte	Conc	Reportable Limit
Acetone	ND	5	Cis-1,2-Dichloroethane	ND	1
Benzene	ND	1	Trans-1,2-Dichloroethane	ND	1
Bromodichloromethane	ND	1	1,2-Dichloropropane	ND	1
Bromoform	ND	1	Cis-1,3-Dichloropropane	ND	1
Bromomethane	ND	2	Trans-1,3-Dichloropropene	ND	1
2-Butanone	ND	2	Ethylbenzene	ND	1
Carbon Disulfide	ND	1	2-Hexanone	ND	2
Carbon Tetrachloride	ND	1	Methylene Chloride	ND	1
Chlorobenzene	ND	1	4-Methyl-2-Pentanone	ND	2
Chloroethane	ND	1	Styrene	ND	1
2-Chloroethyl Vinyl Ether	ND	1	1,1,2,2-Tetrachloroethane	ND	1
Chloroform	ND	1	Tetrachloroethane	10	1
Chloromethane	ND	1	Toluene	ND	1
Dibromochloromethane	ND	1	1,1,1-Trichloroethane	2	1
1,2-Dichlorobenzene	ND	1	1,1,2-Trichloroethane	ND	1
1,3-Dichlorobenzene	ND	1	Trichloroethane	64	1
1,4-Dichlorobenzene	ND	1	Trichlorofluoromethane	ND	1
Dichlorodifluoromethane	ND	1	Vinyl Acetate	ND	1
1,1-Dichloroethane	ND	1	Vinyl Chloride	ND	1
1,2-Dichloroethane	ND	1	Total Xylenes	ND	2
1,1-Dichloroethene	ND	1			



Malcolm-Pirnie, Inc.
3775 Redwood Circle
Palo Alto, CA 94306

Date Sampled: 08/09/96
Date Received: 08/12/96
Date Extracted: P/T
Date Analyzed: 08/13/96
Work Order No.: 96-08-237
Method: EPA 8240B
Page 3 of 3

Attn: Jim Babcock
RE: Northrop Y-12

All concentrations are reported in µg/L (ppb).

Sample Number: Method Blank

Analyte	Conc	Reportable Limit	Analyte	Conc	Reportable Limit
Acetone	ND	5	Cis-1,2-Dichloroethene	ND	1
Benzene	ND	1	Trans-1,2-Dichloroethene	ND	1
Bromodichloromethane	ND	1	1,2-Dichloropropane	ND	1
Bromoform	ND	1	Cis-1,3-Dichloropropene	ND	1
Bromomethane	ND	2	Trans-1,3-Dichloropropene	ND	1
2-Butanone	ND	2	Ethylbenzene	ND	1
Carbon Disulfide	ND	1	2-Hexanone	ND	2
Carbon Tetrachloride	ND	1	Methylene Chloride	ND	1
Chlorobenzene	ND	1	4-Methyl-2-Pentanone	ND	2
Chloroethane	ND	1	Styrene	ND	1
2-Chloroethyl Vinyl Ether	ND	1	1,1,2,2-Tetrachloroethane	ND	1
Chloroform	ND	1	Tetrachloroethene	ND	1
Chloromethane	ND	1	Toluene	ND	1
Dibromochloromethane	ND	1	1,1,1-Trichloroethane	ND	1
1,2-Dichlorobenzene	ND	1	1,1,2-Trichloroethane	ND	1
1,3-Dichlorobenzene	ND	1	Trichloroethene	ND	1
1,4-Dichlorobenzene	ND	1	Trichlorofluoromethane	ND	1
Dichlorodifluoromethane	ND	1	Vinyl Acetate	ND	1
1,1-Dichloroethane	ND	1	Vinyl Chloride	ND	1
1,2-Dichloroethane	ND	1	Total Xylenes	ND	2
1,1-Dichloroethene	ND	1			

Reviewed and Approved

William H. Christensen
William H. Christensen
Deliverables Manager

on 08/14/1996

ND denotes not detected at indicated reportable limit.

Each sample was received by CEL chilled, intact, and with chain-of-custody attached.



Malcolm-Pimie, Inc.
3775 Redwood Circle
Palo Alto, CA 94306

Date Sampled: 08/09/96
Date Received: 08/12/96
Date Extracted: P/T
Date Analyzed: 08/12/96
Work Order No.: 96-08-237
Method: EPA 8020A
Page 1 of 1

Attn: Jim Babcock
RE: Northrop Y-12

All concentrations are reported in µg/L (ppb).

<u>Analyte</u>	<u>Concentration</u>	<u>Reportable Limit</u>
Sample Number: Trip Blank		
Benzene	ND	0.3
Toluene	ND	0.3
Ethylbenzene	ND	0.3
Total Xylenes	ND	0.6
Sample Number: Method Blank		
Benzene	ND	0.3
Toluene	ND	0.3
Ethylbenzene	ND	0.3
Total Xylenes	ND	0.6

Reviewed and Approved


William H. Christensen
Deliverables Manager

on 08/14/1996

ND denotes not detected at indicated reportable limit.

Each sample was received by CEL chilled, intact, and with chain-of-custody attached.

QUALITY ASSURANCE SUMMARY
Method EPA 8240B

Malcolm-Pirnie, Inc.
Page 1 of 1

Work Order No.: 96-08-237
Date Analyzed: 08/13/96

Matrix Spike/Matrix Spike Duplicate
Sample Spiked: NMW-2

Analyte	MS%REC	MSD%REC	Control Limits	%RPD	Control Limits
Benzene	100	103	37 - 151	3	0 - 25
Chlorobenzene	100	102	37 - 160	2	0 - 25
Toluene	101	104	47 - 150	3	0 - 25
1,1-Dichloroethene	95	101	D - 234	6	0 - 25
Trichloroethene	103	113	71 - 157	9	0 - 25

Surrogate Recoveries (in %)

Sample Number	S1	S2	S3
NMW-1	97	102	98
NMW-2	97	101	97
Method Blank	97	100	97

Surrogate Compound	Water %REC Acceptable Limits	Soil %REC Acceptable Limits
S1 > 1,2-Dichloroethane-d4	76 - 114	70 - 121
S2 > Toluene-d8	88 - 110	81 - 117
S3 > 1,4-Bromofluorobenzene	86 - 115	74 - 121

Reviewed and approved: William H. Christensen on 08/14/1996
William H. Christensen
Deliverables Manager

QUALITY ASSURANCE SUMMARY
Method EPA 8020A

Malcolm-Pirnie, Inc.

Work Order No.:

96-08-237

Page 1 of 1

Date Analyzed:

08/07/96

Matrix Spike/Matrix Spike Duplicate

Sample Spiked: 96-08-138-1

<u>Analyte</u>	<u>MS%REC</u>	<u>MSD%REC</u>	<u>Control Limits</u>	<u>%RPD</u>	<u>Control Limits</u>
Benzene	101	102	39 - 150	1	0 - 25
Toluene	98	101	46 - 148	3	0 - 25
Ethylbenzene	94	93	32 - 160	1	0 - 25
m,p-Xylene	89	87	45 - 150	2	0 - 25
o-Xylene	88	87	45 - 150	1	0 - 25

Surrogate Recoveries (in %)

<u>Sample Number</u>	<u>S1</u>
Trip Blank	104
Method Blank	104

Surrogate Compound

S1 > 1,4-Bromofluorobenzene

%REC
Acceptable Limits

65 - 140

Reviewed and approved:

William H. Christensen

William H. Christensen
Deliverables Manager

on 08/14/1996